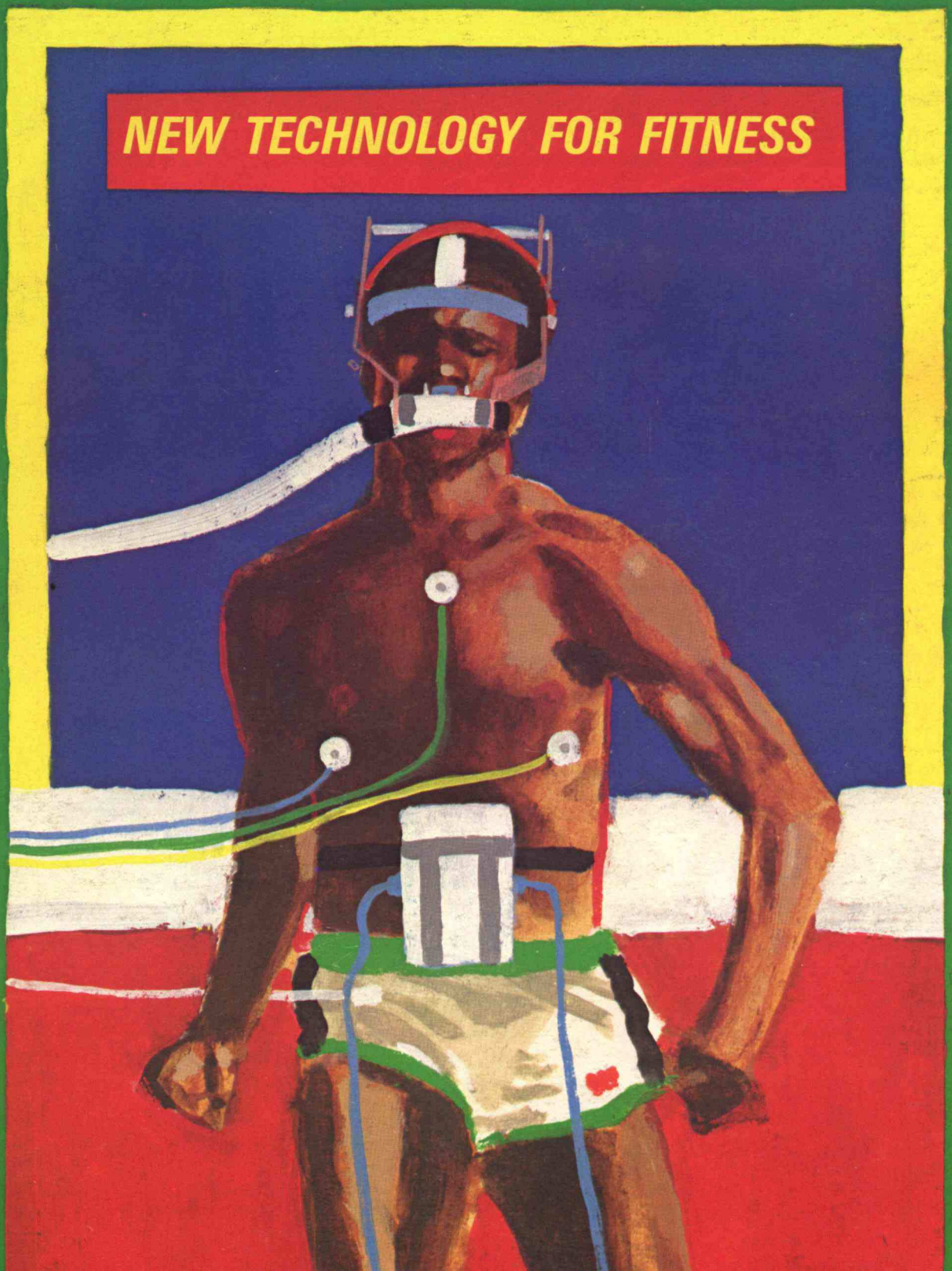
WHY WE SHOULD STOP SATELLITE KILLERS NOW

Technology Review

EDITED AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY AUGUST/SEPTEMBER 1984 $3.00

NEW TECHNOLOGY FOR FITNESS



technology
review
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Plus, Tempo has the world's most advanced automotive computer, the EEC-IV. It processes up to 250,000 commands per second. Coupled with Tempo's 2300 HSC (High Swirl Combustion) engine, you get quick power response from a standing start and at cruising speed.

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When we say "Quality is Job 1," we are talking about more than a commitment. We are talking about results. A recent survey concluded Ford makes the best-built American cars. The survey measured owner-reported problems during the first three months of ownership of 1983 cars designed and built in the U.S. And that commitment continues in 1984.

*Based on EPA Interior Volume Index.

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Ford

AUG/SEPT 1984 VOL. 87 NO. 6

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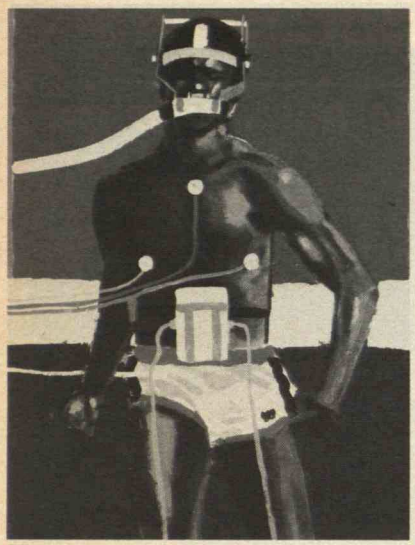

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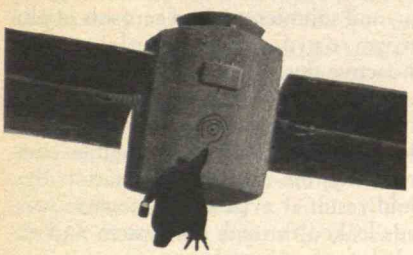

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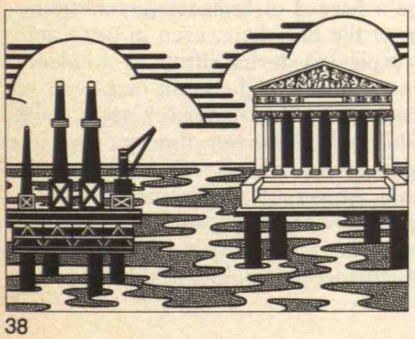

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LETTERS

Plutonium Poisoning

In "The Fallacy of Laser Defense" (*April, page 30*), Jonathan Tucker points out that if the United States developed a BMD system (and became less vulnerable), the Soviet Union would feel more vulnerable. The effect would be to destabilize the MAD stalemate. One suggestion I have seen elsewhere is that we *cooperate* with the Soviet Union in developing a BMD system. Give the Soviets our laser and space "secrets," and we might even learn from them. We'll both have the best available defense against ballistic missiles, and the cooperation itself would only improve relations.

John D. Fogarty
Columbia, Md.

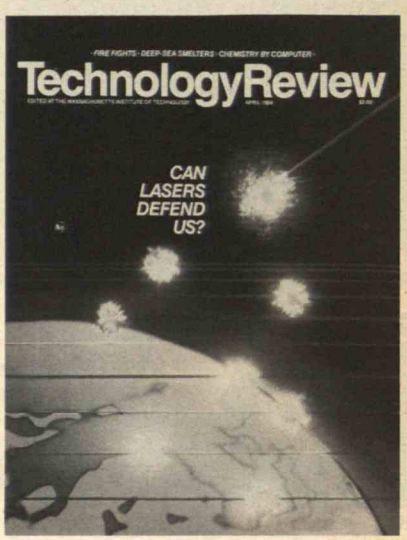
Neither Tucker nor Meinel mentions what will happen to the plutonium in a nuclear weapon when it is either detonated or destroyed. If a nuclear bomb is damaged or destroyed by high explosives, pellets, or a laser or particle beam, the plutonium would either be vaporized in a low-yield detonation or burned up in the atmosphere. If the weapon is successfully detonated, unfissioned plutonium will be vaporized. The amount of this exceedingly toxic material dispersed throughout the atmosphere during a large-scale attack would be millions of times that required to annihilate the human race.

How long might the plutonium remain in the atmosphere, perhaps attached to particulates or perhaps in molecular form resulting from chemical reactions with atmospheric constituents? Has anyone calculated the amount of plutonium that might be ingested from the air, and later from water and food?

If ingestion of plutonium is a serious problem, the United States would not wish to use nuclear weapons either offensively or defensively. Furthermore, if the Russians were to use them, a good defensive system would have to destroy nuclear weapons without vaporizing plutonium.

Frank J. Allen
Bel Air, Md.

Jonathan Tucker responds:
The primary danger associated with plutonium is from inhaling the highly carcinogenic radioactive dust, not from ingesting it. This is because the body does not absorb plutonium as rapidly through the gastrointestinal tract as through the lungs.



The amount of plutonium released into the atmosphere if a BMD were to destroy enemy warheads would depend on the method of destruction and the altitude. The greatest contamination would result if the reentry vehicles were destroyed within the atmosphere by kinetic-energy weapons. In this case, the roughly five kilograms of plutonium metal inside each warhead would be fragmented into small chunks and particulates. Because plutonium burns when heated in the presence of atmospheric oxygen, these fragments would vaporize on reentry, forming micron- and submicron-sized aerosols of plutonium oxide. The resulting fine radioactive dust would disperse in the atmosphere and eventually fall to earth. However, the danger from such plutonium fallout would clearly be negligible compared with the massive devastation that would result if even a few nuclear warheads leaked through the system and exploded on the ground.

A space-based BMD system might itself pose a hazard of radioactive contamination of the biosphere, even in peacetime. An explosion during liftoff or accidental reentry of one of the multi-megawatt reactors necessary to power BMD lasers could result in a major disaster. Thus, the large-scale use of reactors in space poses a real danger of contaminating the atmosphere with significant amounts of radioactive material, with long-term consequences for public health.

Hopping MAD

I am appalled by the inconsistencies in Carolyn Meinel's arguments for developing a ballistic-missile defense *("Fighting MAD," April, page 31):*

☐ The fact that "making nuclear bombs and ICBMs work is extremely tricky" suggests to Meinel "that they may be vulnerable to defensive technologies." But making any BMD work will be even trickier, and such a system would itself be that much more vulnerable to any new set of offensive technologies and strategies.

☐ Meinel addresses a common concern that "ballistic-missile defenses might make world leaders more willing to hazard war, and even if only a few nuclear warheads leaked through, millions could die." Her response is to cite Murphy's Law: if anything can go wrong [with MAD], it will—sooner or later. However, she only reinforces the notion that something can (and will) go wrong with BMD.

☐ Meinel asks whether by installing a BMD, the United States will pressure the Soviet Union to launch its missiles before they become useless. She cites the development of battlefield nuclear weapons for NATO as a precedent to dispel this fear, but her argument falls through. Our development of nuclear warheads in eight-inch artillery shells did not threaten the Soviet Union with a first-strike capability.

☐ Meinel writes that Lockheed's Max Hunter regards vested interests behind U.S. nuclear weapons to be the most dangerous opponents of his work on space-based lasers. But Lockheed is a vested interest behind U.S. nuclear weapons. As Meinel herself admits, "Strategic defense is au courant. Lasers have dazzle." We must all look beyond our immediate personal pleasures to understand that the technology we develop is only real in the context of political power. In the current political context, BMD will only lead to a runaway race of countermeasures and counter-countermeasures.

David C. Ricks
Ashaway, R.I.

While Hans Bethe *("Face-Off on Nuclear Defense," April, page 38)* and Jonathan Tucker put forward specific physical and strategic reasons for doubting the practicality of a BMD system, Edward Teller and Carolyn Meinel carefully avoid addressing any technical details. Meinel also proclaims that her belief in laser BMD is independent of the details of any specific technology. "Lasers have dazzle. . . . They are McLuhansque"—how can the dry details of engineering feasibility stand in the way of such glamor?

Teller also makes the possibility of laser BMD an article of faith. To every critical point he responds that data supporting his case cannot be revealed for reasons of national security. This policy raises a question that goes beyond the BMD debate. Peer review, not merely by members of a researcher's own team but by the international scientific community, is an essential part of the scientific endeavor. But classified research is addressed not to the scientific community but to possible sources of funding within the government, and is judged on political rather than scientific merit.

That is why the increasing fraction of the nation's scientific resources that is devoted to military endeavors may be providing us with neither good science nor good defense.

John Dewey Jones
Farmington Hills, Mich.

Carolyn Meinel responds:

I agree with Mr. Jones regarding peer review, but I took the technological optimist's viewpoint. As a coworker once complained, "This is classified, which means this information is highly unlikely to ever fall into the hands of someone who could help us solve this problem." Teller has fought long and visibly to ease security constraints. When he says he can't talk because something is secret, it's not his intent to hide. It's a reaction he's developed over years of trying to rub into everyone's face the problems of secrecy restrictions.

I avoided technical detail in my article because I feel it is a diversion from the real issue: what defense policy should we choose to guide our research? If we assume a BMD could work, is it worth it? Dare we allow rather fragmentary, strongly disputed evidence to convince us that there's no point in even trying? Dr. James Fletcher's team of scientists that tackled the Star Wars concept last year started out highly skeptical, but nearly all members emerged convinced that the United States has a good shot at developing an economically and technically feasible BMD.

I agree with Mr. Ricks that adding BMD to a first strike capability could be disastrous. General James Abrahamson, director of the Strategic Defense Initiative, was obviously aware of this in his testimony before the Senate Armed Services Committee on April 24: "Effective defense could obviate the need for major and costly offensive ballistic missile modernization programs. . . . As we proceed with our research program and, if it is successful, through subsequent steps, we intend to make each step add stability and decrease the risk of nuclear conflict. This can be [done] only by pursuing arms-control strategies in concert with our technology developments."

Continued on page 79

ROBERT C. COWEN

The Price of Leaving UNESCO

THE Reagan administration's policy toward international organizations in general, and UNESCO in particular, can be summed up in a sentence. To quote Jean Bergaust, deputy assistant secretary of state, "We no longer see any reason to excuse inefficiency and ineffectiveness or anti-American action just because they may occur in an international organization." Hence the department's announcement last December that unless the unhappy agency reforms itself, the United States will withdraw from the United Nations Educational, Scientific, and Cultural Organization, taking with it 25 percent of the agency's funding.

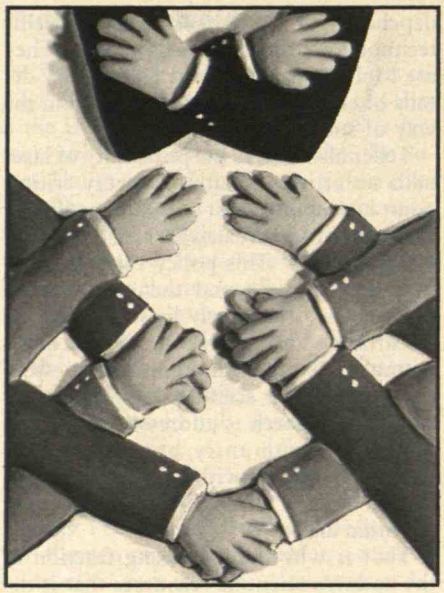
The policy may be satisfying philosophically. And the withdrawal announcement has certainly caught UNESCO's eye. But if the United States makes good on its threat, it may well find it has cut off its nose to spite its face.

Bergaust says that the State Department is already seeking advice from such bodies as the National Academy of Sciences about "alternative mechanisms through which viable international science cooperation can be maintained to satisfy the needs of the American scientific community." Many knowledgeable U.S. scientists see no credible alternatives in fields such as oceanography and environmental science, where UNESCO is now the preeminant medium for cooperation. Those scientists think the United States would simply find itself frozen out of some important fields of international scientific endeavor. Such fears were strongly articulated at a symposium at the annual meeting of the American Association for the Advancement of Science (AAAS) in New York.

Moving Toward Reform

The shock of the U.S. stand has already provoked significant effort toward reforming UNESCO. A working party is to report to the agency's Executive Board this fall on what might be done. In fact, there is wide agreement on the need for reform both among UNESCO member nations

ROBERT C. COWEN is science editor of the Christian Science Monitor *and former president of the National Association of Science Writers.*



and among U.S. critics of the administration's withdrawal threat. UNESCO is almost universally faulted for being badly managed and subservient to political pressure from Third World nations, and for spending 80 percent of its budget on its Paris headquarters. Yet even the Reagan administration acknowledges that when it comes to projects actually carried out in the field, UNESCO has generally done a good job.

Given the recent signs of reform, the administration's continuing motion toward withdrawal raises the suspicion that it is acting as much out of pique over the anti-American rhetoric of many U.N. agencies as out of concern for UNESCO's managerial malfeasance. Bergaust reinforced such suspicions during the AAAS symposium by making several references to anti-Americanism, observing that "words have meaning and they also have consequences."

Aware of such attitudes within the administration, Dr. Roger Revelle of the University of California at San Diego—a former oceanographer and a widely experienced statesman of science—remarked that "the U.S. position, to put it bluntly, . . . is they would like to stop the world because they want to get off."

Venezuelan Ambassador Designate to UNESCO Alfredo Planchart made a similar point by saying that "the U.S. is, after all, the most powerful country—certainly in science, certainly in communications, probably in education, and possibly even in culture. I think the United States would be very sorely missed in a world forum such as UNESCO. And I think the United States should put up a little bit with some of the anti-Western and anti-U.S. sentiments that do exist in such forums."

The Only Game in Town

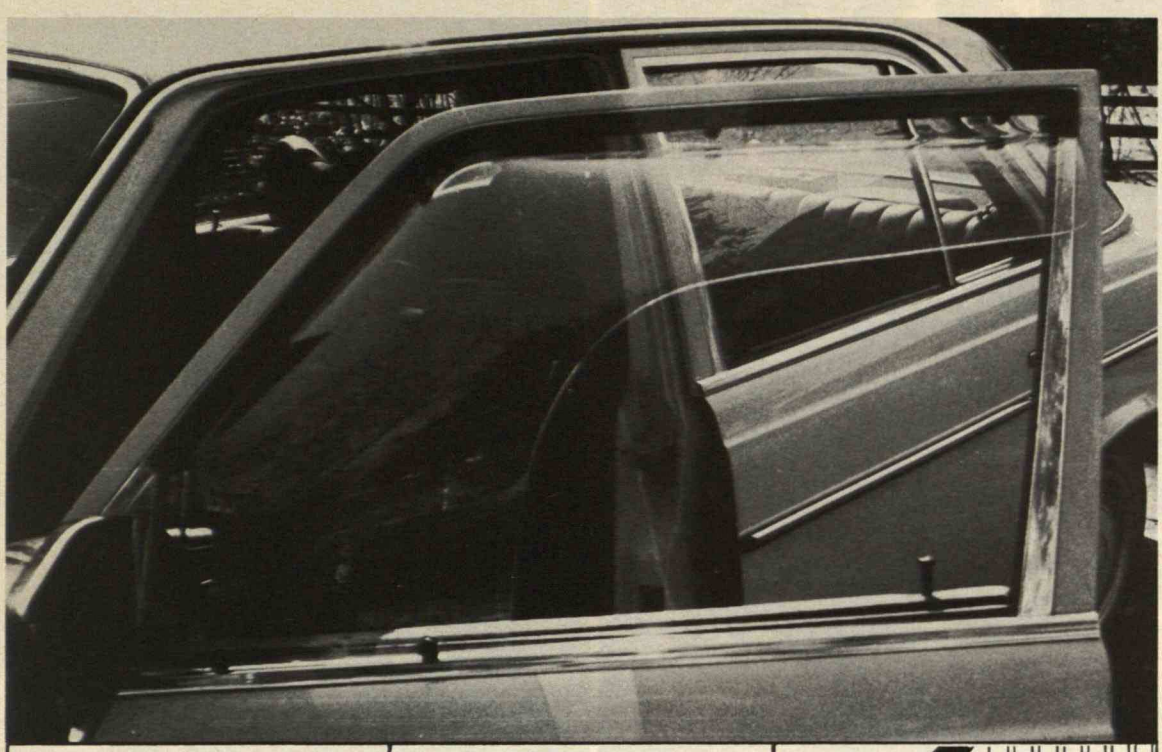
This is very much what many U.S. scientists familiar with UNESCO want. However, in spite of assurances that it is seeking their advice, the administration does not seem to be listening to these scientists.

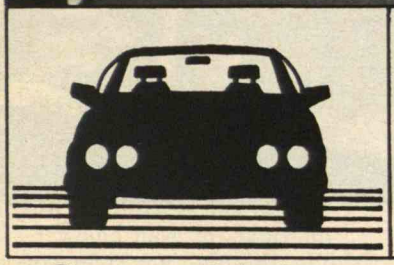
It speaks of using nongovernmental organizations such as the International Council of Scientific Unions (ICSU) as alternatives for organizing scientific cooperation. Yet Samuel B. McKee of the National Academy of Sciences explained that this would be impractical. Nongovernmental bodies such as ICSU have no money to fund programs and cannot commit national governments to funding. Thus, while ICSU can plan programs, those cannot be implemented without the involvement of an intergovernmental organization. And that often means UNESCO.

Revelle amplified this point by noting that UNESCO is the developing countries' agency, in terms of the concrete benefits that it can confer. And oceanography, for example, often cannot be done effectively without such countries' cooperation. Some 40 percent of the ocean now falls within nations' Exclusive Economic Zones granted by the Law-of-the-Sea Treaty (which the United States has not yet ratified). Referring to the administration's hope of using ICSU as an alternative to UNESCO in facilitating research in such subjects, Revelle asked rhetorically, "How ridiculous can you get?"

The United States and its friends would do well to keep up the pressure on UNESCO until satisfactory reforms are enacted. This requires patience and diplomacy not colored by an immature sensitivity to hostile rhetoric. The United States needs the kind of medium for international cooperation that UNESCO is meant to provide, and it should take its place in such a forum, however uncomfortable that may become. Instead of being overly concerned that words may "have meaning and consequences," the Reagan administration might consider, as several scientists noted, that "sticks and stones may break my bones but words will never hurt me." □

ILLUSTRATION: KEN GOLDSTROM





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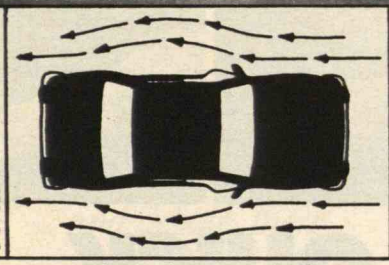

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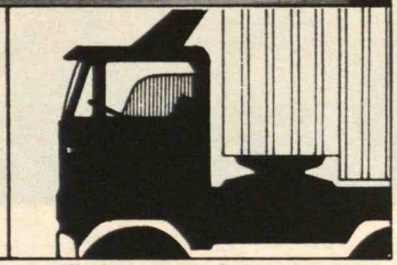

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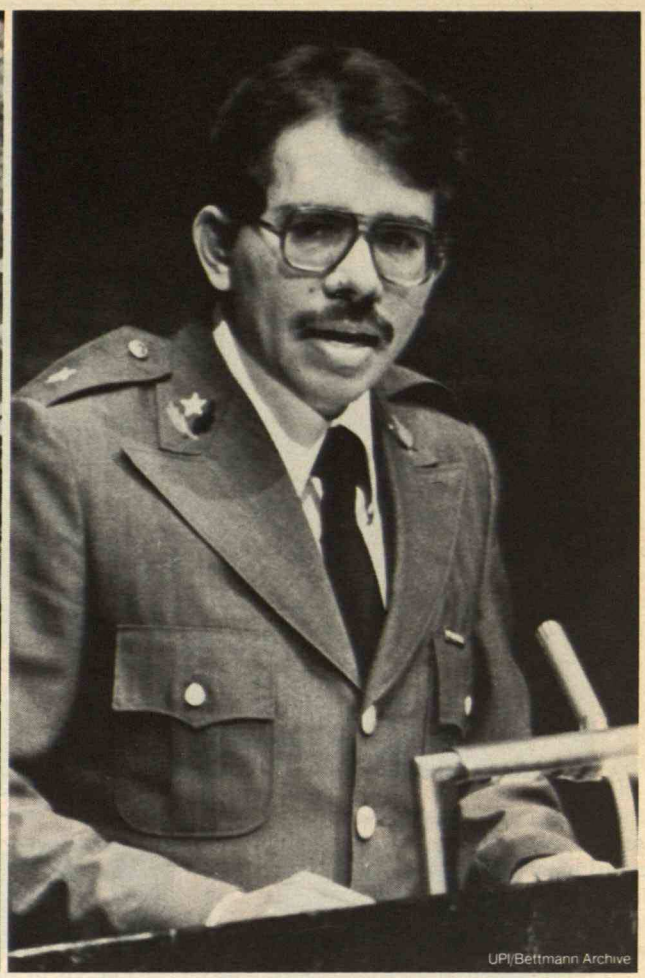

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SAMUEL C. FLORMAN

The Technology of Print: Is Faster Better?

THE technology of printing and publishing has undergone extraordinary changes in recent years. Like most citizens, I have not given much thought to the technological advances themselves, or to their effect on the way people think and communicate. Recently, however, I had an experience that caused me to reflect on what has been happening.

One Tuesday afternoon I received a telephone call from an editor of *The New York Times* Sunday business section. Would I be willing to write a few hundred words about a new book? I had already read the book, and not having any writing commitments for the forthcoming month, I said yes.

"By the way," I asked, "what is your deadline?"

"Thursday," was the reply.

"Which Thursday?" I asked.

"*This* Thursday," he said, "for this Sunday's section, which is printed on Friday."

I hung up the phone feeling uneasy. I am used to urgency and deadlines in my daily work, especially when submitting bids for construction projects. But writing under pressure is something else again. Within the space of three or four hours—not weeks—I would have to clarify my thoughts, formulate my opinions, and then set them forth with a reasonable amount of grace.

I managed to accomplish these tasks, although when my deadline came I was still crossing out, rearranging, and groping for thoughts that were just out of reach. Thursday morning I called the editor to say that I would need time to get the piece typed and delivered. No need, was the reply; he would merely connect me to the recording room. In a few moments I was dictating onto a tape recorder somewhere in the bowels of the *Times* building. My words were then transcribed into the paper's central word-processing computer. The person who performed this single operation has replaced the many typists, linotype operators, copy boys, and other assorted people who made the splendid chaos of the old newspaper office.

Later in the day the editor telephoned to say he had to make substantial cuts. This he could do by bringing my work onto his personal screen and typing in his changes. The computer then printed out the edited piece and it was sent to me by messenger—a nice old-fashioned touch that will be obsolete when all writers receive copy transmitted electronically.

For civilized discussion and debate, there should be time for deliberation.

It is a time-honored custom for New Yorkers to buy certain sections of the Sunday *Times* as early as Friday night. I joined the early birds and was amazed to see on the printed page those sentences that I had first conceived less than 48 hours before and had revised that same day.

News versus Wisdom

Long before the invention of the computer, newspapers were known for the speed with which they managed to get the news before the public. I have always wondered how reviewers of plays and concerts could dash off their pieces in an hour after the curtain descends, and how political columnists can opine on world events practically as they occur. The computer has speeded up a process that was already proceeding at a breathtaking pace.

Participating in this process could not help but evoke feelings of admiration for the technical ingenuity entailed. But at the same time I found the experience discomfiting. There is something to be said, I suppose, for immediacy—for thinking "off the top of one's head," as it were. But for civilized discussion and debate—which is what we try to achieve when we write and read essays—there should be time for deliberation, for rethinking those insights that at first seem so compelling and later appear so flawed.

If the future could be defined by extrapolation, one would predict that writing, printing, and reading as we know them will disappear. Work is already under way on computers that will convert spoken words into written text. Futurists tell us that each household will be furnished with electronic screens to which we will conjure news, mail, articles, and books (if they still exist). People will "network," communicating instantaneously with any person or any place in the world.

Communicating with Care

I hope and believe that this vision of the future is considerably wide of the mark. We should have learned by now that extrapolation is an unreliable guide, particularly with respect to the course of "modernity." Not long ago, we were enthusiastically covering our landscapes with highways and parking lots when we suddenly discovered how much we valued greenery and wilderness and how readily we can effectuate programs that reflect these values. Similarly, I foresee a time when we will choose to speak more slowly and write more deliberately.

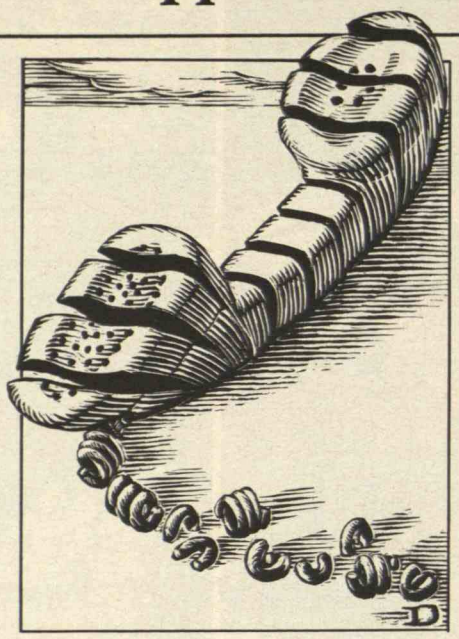
I know that many respected writers are infatuated with their word processors and delighted with the ways their words can be disseminated. I, too, enjoy anything that makes life easier, and it surely is nice to be able to revise what one has written without thinking it will have to be completely retyped. But if, as I believe, the quality of our thought is related to both leisurely contemplation and the measured function of our hand, then ever-increasing speed may have an adverse effect on what we write. I suggest that our desire to communicate quickly must be tempered by our need to converse meaningfully. □

SAMUEL C. FLORMAN, a civil engineer, is author of Engineering and the Liberal Arts, The Existential Pleasures of Engineering, *and* Blaming Technology.

ILLUSTRATION: MICHAEL CRAWFORD

MARSHALL I. GOLDMAN

The Flexible Approach to Antitrust



It's not that "Ma Bell" was ever my favorite person, but I am coming to appreciate why one should never speak ill of the dead. The Bell Telephone system is not dead, but it is certainly not as robust as it once was. Virtually every hardware and appliance store now legally sells new telephone equipment. For several years, firms like MCI and Sprint have carried long-distance calls in competition with AT&T, once an unthinkable option. Unfortunately, most of the new brands of telephones seem to be more poorly built than those that AT&T used to rent, and the long-distance lines sound more and more as if they were designed and built in the 1920s.

Watching the degeneration of what was once the world's finest phone system is a depressing experience. Except for the new companies that now find themselves with expanded markets to sell to, most people have little to cheer about, particularly because there is every reason to believe that as the system becomes more and more fragmented, service will continue to deteriorate and costs will continue to rise.

What makes this deterioration in equipment and service particularly distressing is that much of it is the direct result of conscious government policy. On the long-held assumption that more rather than less competition is the wisest economic policy, the U.S. Department of Justice and its Anti-Trust Division instituted a suit in 1974, charging that the old Bell System was a monopoly that restrained the growth of the telephone industry. A federal judge was convinced and concluded that the American public would be best served by breaking up the company and exposing the now-dismembered Bell units to competition.

As a nation, we are opposed to monopoly in principle. We reason that the more competition there is, the more likely it is that prices will be lower and innovation and quality of service higher. In most instances, that is sound reasoning. However, the pace of technological progress and the foothold other countries have gained in marketing new technologies sometimes calls into question that basic principle. In a growing number of industries, bigness per se may not necessarily be against the best interests of the U.S. economy. What is happening to our phone service and also to the computer industry demonstrates why the economic standards of the past may produce unanticipated and undesired results when challenged by dynamic technological change.

Watching the degeneration of the world's finest phone system is a depressing experience.

MARSHALL I. GOLDMAN is professor of economics at Wellesley College.

Built for a Lifetime

For many years, the phone system seemed to work with reasonable efficiency. The need to connect phone subscribers with telephone wires made the operation of the service so expensive that hardly anyone ever considered creating a competitive service. This monopoly served the consumer well. Because the phone company made all the decisions about phone service and was allowed to set rates to cover costs and make a reasonable profit, it insisted on installing well-made, if expensive, equipment. More often than not, Bell Telephone's wholly owned subsidiary, Western Electric, overengineered its phones, lines, and switchboards. A Bell telephone was built to last a lifetime, even though only five or ten years might have sufficed. This overengineering ensured that the phones at both ends of the line were of high quality.

What opened the floodgates to non-AT&T equipment was that communications technology began to change. Microwave transmissions via a satellite dish enabled phone calls to be made without an expensive wire system. At about the same time, non-Western Electric manufacturers began to make less expensive, albeit sometimes less well-made, equipment. Thus, for the first time, outside suppliers were able to argue that they could connect long-distance phone callers at a cheaper rate, if only AT&T's monopoly were abolished.

Undoubtedly, new technologies such as microwave transmission would have made it increasingly difficult for AT&T to have maintained its monopoly. But outside companies could have continued to compete with AT&T for long-distance phone service even if Ma Bell had retained its monopoly over local calls and service. It's hard to see how the separation of AT&T from its local subsidiaries will ultimately improve the quality or cost of phone service.

The clash between outmoded economic theory and changing technology has also had a negative impact on other sectors of the U.S. economy. For example, from 1969 to 1983 the Justice Department conducted a very costly antitrust suit against IBM. Until the Justice Department withdrew its suit, there was good reason to believe that the judge would have ruled against IBM for monopolizing the market for mainframe computers. Of course, IBM is no angel. At times it has treated its competition ruthlessly and stifled innovations that would make some of its existing product lines obsolete. Nonetheless, IBM has been one of our country's leading innovators and exporters. Yet because of this antitrust case, IBM has been forced to spend millions of dollars in legal fees and executive time, presumably at the expense of more productive and innovative work.

At the same time, Japanese firms succeeded—with government support, not opposition—in building computers that rival IBM's. Thus today we no longer have to worry about IBM's monopoly in the

ILLUSTRATION: BOB DAHM

domestic computer market. Instead we have to worry that a Japanese firm will monopolize the international market.

What is happening—in the computer and semiconductor industries at least—is that our traditional criterion for judging market collusion and restraint has become outdated. The old measure of domestic market share has become meaningless. American manufacturers no longer play the dominant role in a growing number of markets; in a few cases, they play no role at all. For instance, there are virtually no American manufacturers of 35mm cameras or video recorders. Today the appropriate criterion for judging monopoly is share of the world market. Our concept of competition should be broadened to include foreign manufacturers, not just American firms.

Encouraging Joint Ventures

For years the U.S. government has also taken a dim view of cooperative ventures between two or more competitors. The fear is that such joint efforts, no matter how pure the motivation, will give rise to price collusion and market sharing. There is certainly enough evidence in court records to indicate that such unethical dealings do take place. But here again, the old criterion of market share is no longer adequate. We must consider the cost of duplicating research facilities and projects as technology becomes ever more complex.

Accordingly, in a growing number of instances, the U.S. government is actually encouraging joint ventures among American competitors so they can compete against foreign firms for a share of the world market. While the Justice Department is to be commended for permitting ventures such as the new Microelectronics and Computer Technology Corporation (MCC), a research and development enterprise sponsored by 12 companies, businesspeople report that government officials are still of two minds about the wisdom of such an approach. While they agree in theory, in practice they keep establishing all kinds of conditions and obstacles. Their intent is to restrict these ventures to a particular product and purpose, but in the process they tend to inhibit the whole operation. Yet to the extent that joint efforts such as the MCC make it possible for U.S. firms to keep abreast of technological innovation in Japan, they appear to foster rather than stifle competition.

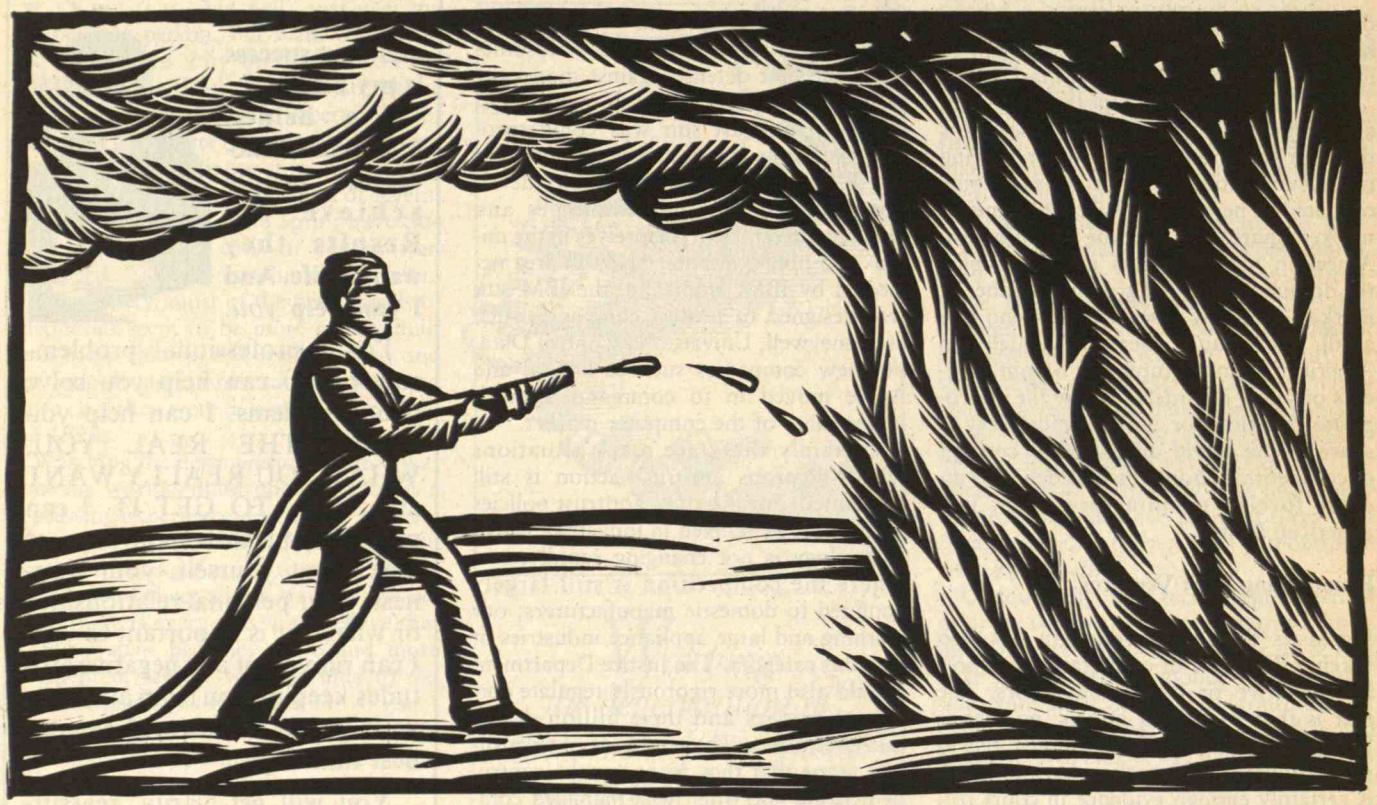
We must also recognize that as important as antitrust law is as a weapon, sometimes the best defense against monopoly is technology itself. Thus, in many ways, the IBM antitrust suit was counterproductive. For example, during the course of the IBM trial, a host of companies developed new computer technologies and managed to establish themselves in the micro- and mini-computer field, an area neglected by IBM. Ironically, the IBM suit was designed to protect companies such as Honeywell, Univac, and Control Data, but new companies such as Digital and Apple moved in to command a much larger share of the computer market.

Certainly there are many situations where vigorous antitrust action is still warranted. For instance, antitrust policies should not be relaxed in industries where technology is not changing rapidly, and where the competition is still largely confined to domestic manufacturers; our clothing and large appliance industries fit into this category. The Justice Department should also more rigorously regulate corporate raiders and their billion-dollar takeover offers. The tenderers of such offers argue that they want to take control of existing and often well-managed companies to introduce further improvements. In many cases, however, the real purpose is to frighten management into finding a more compatible buyer. This second buyer, "a white knight," begins to buy stock to assure control, pushing up the price of the stock. Eventually, the white knight buys out the stock of the original tenderer, who realizes a profit that sometimes reaches hundreds of millions of dollars. This is good for the tenderers but bad for the corporation, which now disappears, and ultimately for the U.S. economy. In such cases, the current laissez-faire approach is doing more harm than good.

What is needed is a more sophisticated and flexible approach to antitrust activity. The recent passage of House bill 504 is a step in the right direction because it facilitates joint R&D ventures by otherwise competing firms. Essentially, this bill and a similar bill pending in the Senate make allowances for industries undergoing rapid technological change and thus in need of strong research programs. But in less technologically dynamic sectors of the economy, similar allowances would be counterproductive. In developing a workable anti-trust policy today, the key word is flexibility. □

BY JUDITH RANDAL

Too Little Aid for AIDS



To have heard Margaret Heckler tell it at her April 23 news conference, it was all over but the shouting. Only a year earlier, said the secretary of health and human services, she had "made the conquest of AIDS the federal government's number-one priority." And now not only had the "probable cause" of acquired immune deficiency syndrome been found; it had also become possible—thanks to a newly developed blood test—to identify AIDS victims and AIDS-tainted blood "with essentially 100 percent certainty." And to top this dazzling array of accomplishments, Heckler announced that a preventive vaccine should be "ready for testing in approximately two years."

Not so fast, madam secretary. The truth is that the cause of AIDS may or may not have been found. And there is no evidence that anything discovered to date will make a dime's worth of difference to people who already have AIDS or get it in the next few years. Even the blood test is not yet a fait accompli. And as for the vaccine, only the wildest of optimists expect it to be a reality before the end of the decade.

JUDITH RANDAL is the science reporter for the New York Daily News *in Washington.*

I must also take exception to Heckler's insistence that the Reagan administration has left no stone unturned in responding to the AIDS crisis. For openers, the mayors of New York, San Francisco, Los Angeles, and other cities hit hardest by the AIDS epidemic have learned to their sorrow that they can count on precious little help from Washington—particularly when it comes to paying the enormous medical bill for AIDS patients.

AIDS is a new disease and one that doctors do not know how to treat. Accordingly, any medication for it is considered experimental therapy. As many health insurance plans do not reimburse for experimental therapy, their payments have been limited to coverage for symptomatic treatment of the complications of AIDS, rather than for tackling its underlying immune defect. Hospital costs for AIDS patients can easily rise to between $60,000 and $100,000 per case, and many patients quickly exhaust whatever private coverage they have. Yet most remain ineligible for Medicaid because they are young, unmarried, homosexual males. People under 65 don't qualify for benefits unless they have minor children. As a result, some cities have been left holding the financial bag for some staggering medical bills. For New York City, that bill totals $70 million.

Under the Reagan administration, the principal arms of the Public Health Service—the Centers for Disease Control (CDC) and the National Institutes of Health (NIH)—have been similarly strapped for funds. "The time wasted pursuing money from Washington ... has sandwiched those responsible for research and control between a massive pressure to do what is right and an unmovable wall of inadequate resources," CDC's AIDS coordinator for laboratory resources, Dr. Donald Francis, wrote to a superior in April 1983. "Our government's response to this disaster has been far too little."

Francis might have added that whatever money the CDC did manage to scrounge up to combat AIDS was at the expense of eight of the agency's other projects. Among those canceled, postponed, or trimmed were the monitoring of other sexually transmitted diseases (such as herpes and gonorrhea), and the studies of rabies, which has been spreading up the Eastern seaboard.

Austerity also prevailed at the NIH. Various in-house research efforts were

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ILLUSTRATION: ANTHONY RUSSO

SCIENCE/SCOPE

In designing and making a satellite part entirely via computer, Hughes Aircraft Company developed what may be a first in computer-aided design/computer-aided manufacturing. The part is a launch lock pivot plate for the Intelsat VI communications satellite. (The plate keeps the inner and outer sections of the spacecraft together until it is time to begin the spun/despun operation in space. This operation stabilizes the satellite in orbit.) The plate was designed on a CADAM system and made on a computerized milling machine driven by a ComputerVision system. Because CADAM lacks the ability to run milling machines without extensive manual manipulation, engineers developed a custom translator. This new programming allowed CADAM data to be understood by ComputerVision and, in turn, by the milling machine. The use of CADAM and ComputerVision in tandem is believed to be an industry first.

Heat pictures are screening printed circuit boards for such defects as open or short circuits and failed components. The Automatic Infrared Test & Inspection System (AITIS) uses a cooled, 60-element infrared detector to create a high-resolution thermogram. A computer isolates faults by comparing a tested board with a master thermogram stored in computer memory. Components that appear too warm or too cool are shown in color-coded temperatures on a video monitor. As a complement to automatic test equipment, AITIS saves time and money. Hughes developed AITIS under its independent research and development programs and contracts with the U.S. Army Missile Command and U.S. Air Force.

An advanced military communications satellite network will let U.S. bombers and airborne command posts remain in continuous contact with designated ground and naval stations anywhere in the world. The new MILSTAR network will consist of satellites in various orbits and hundreds of terminals aboard aircraft, ships, submarines, and in ground units and command centers. Hughes is designing survivable, secure, and jam-resistant terminals for B-1 and B-52 bombers, E-3A Airborne Warning and Control System (AWACS) early-warning aircraft, E4 command post aircraft, VC-137 "Air Force 1," and other aircraft involved in the Air Force portion of the joint services network.

Some of the fastest digital integrated circuits yet built have been demonstrated at Hughes. The circuits, made of gallium arsenide, are biphase clock flip-flops configured to perform frequency division. They were operated at frequencies up to 5.77 GHz, the highest division speed yet reported for integrated circuits operating at room temperature. The circuits were fabricated by electron-beam lithography (using a Hughes system) to produce gate lengths of 0.5 micrometers in the MESFET switching transistors. These gallium arsenide devices could be used in very-high-frequency signal processing or as interfaces to more complex chips, including Very High Speed Integrated Circuits.

Career growth opportunities exist at Hughes Support Systems for a variety of engineers qualified by degree or extensive work experience. They include systems engineers, radar engineers, and software and hardware design engineers for major simulation and test equipment programs. Also, field engineering posts throughout the U.S. offer travel, autonomy, and responsibility for the life cycle of Hughes electronics systems. Please send your resume to Lowell Anderson, Professional Employment, Dept. S2, Hughes Aircraft Company, P.O. Box 9399, Long Beach, CA 90801-0463. Equal opportunity employer. U.S. citizenship required.

For more information write to: P.O. Box 11205, Marina del Rey, CA 90295

HUGHES
AIRCRAFT COMPANY

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reoriented to accommodate work on AIDS, and invitations eventually went to outside scientists to submit proposals for AIDS-related research. However, the peer-review process used to evaluate the resulting grant applications proceeded at a business-as-usual snail's pace more appropriate to a familiar disease than to a rapidly spreading lethal entity. It was thus not until May 1983, fully 18 months after a task force had identified a need for the grants, that any money was released. Indeed, at the annual meeting of the American Association for the Advancement of Science (AAAS) in May, one ranking NIH official acknowledged that "the fact that it took 18 months to put money on the street was a significant problem." The list of such delays—not only at CDC and NIH but also at the Alcohol, Drug Abuse, and Mental Health Administration, whose expertise is needed to sleuth the high incidence of AIDS among intravenous drug abusers—could go on and on.

Despite all these problems, the Reagan administration turned down the chance for new funds. When Congress offered an extra $30 million to help the Public Health Service tackle the AIDS epidemic, Dr. Edward Brandt, assistant secretary of health—prodded by the Office of Management and Budget—said the money wasn't needed. Accordingly, Congress didn't appropriate any funds. Similar party-line sentiments emanating from the NIH that it could easily make do with existing resources quashed any hopes of extra funding there.

The Not-So-Quick Fix

This is not, of course, the impression that Heckler conveys. "Without a day of procrastination, the resources of the Public Health Service have been effectively mobilized," said the prepared statement she distributed at the April 23 news conferences. "A total of $75 million has been spent toward understanding and overcoming this disease."

The figure is correct. It is, however, misleading—for two reasons. One is that $40 million of that $75 million was finally forced on an unwilling administration by Congress last year. The other is the inherent implication that AIDS has now been converted from a health emergency into a manageable problem. Again, the evidence for this is slight.

Take the "probable cause" of AIDS, the HTLV-III virus (human T-cell lymphadenopathy virus, type three), identified by Dr. Robert C. Gallo of the National Cancer Institute and his colleagues. Is it the same virus French researchers have cast in this role and called LAV (lymphadenopathy-associated virus)?

As this is written, no one knows. Nor do scientists know whether either virus actually causes AIDS or is merely a fellow traveler. Animals have been injected with HTLV-III and LAV in the hope of showing cause and effect, but none has become ill. This may be because AIDS is a disease with a long incubation period—2 to 4 years in humans. But other explanations are also plausible. It could be that too few animals

Whatever the next bizarre epidemic, the federal machinery clearly will not be equipped to handle it.

were used to produce conclusive results—again because of funding constraints.

The AIDS blood test is also an unknown quantity. The test has not yet been scaled up for commercial production and once it is, determining its reliability will take time. There are also some sticky questions regarding how to interpret the test's results. Suppose that you are perfectly well and that when you wish to donate blood and are tested for AIDS, the reading is positive, meaning you have antibodies for the HTLV-III virus in your blood. Since scientists do not yet know whether a positive blood test means that you are a carrier or actually slated to become ill, what are you to be told? You and a lot of other people who wish to give blood could at the very least be subjected to needless anxiety and at worst be unfairly stigmatized.

Consider, too, the prospects for the promised vaccine. Although we don't know precisely which virus is responsible for AIDS, scientists are fairly certain that the disease involves a special class of viruses, known as retroviruses (to which both HTLV-III and LAV belong). The genes of most viruses are made of DNA, which then makes RNA. But in retroviruses the reverse occurs, and the genes are made of RNA, which then makes DNA.

Making a vaccine for a virus—let alone a retrovirus—is difficult and time consuming. The virus must be grown in laboratory culture and used intact to make a product that will generate antibodies, the molecules in the body's immune system that attack foreign substances. To make sure the vaccine won't cause the disease, weakened or dead strains of the virus must developed. Other hurdles must also be overcome. For instance, a laboratory-reared retrovirus is somewhat unstable when released from the cells it infects into the surrounding nutrient medium, and its envelope or jacket tends to get lost. Since it is this jacket protein that stimulates the formation of antibodies, collecting enough of this protein for an effective vaccine may be difficult. However, new genetic-engineering techniques may enable scientists to clone this protein and coax bacteria into mass-producing it for a vaccine.

Once (and if) that is accomplished, animal tests must then be conducted to show that the AIDS virus actually causes the disease, and that the vaccine is capable of safely neutralizing it. Human field trials are also required before the vaccine can be widely used. All this suggests that an AIDS vaccine is probably six to eight years away, rather than only two years as Heckler predicted.

In the meantime, no one is known to have recovered from AIDS, and the problem is not going away. The number of cases continues to double about every six months, and because the incubation period is so long, a lot more cases are certainly in the pipeline. Since more than 4,600 AIDS patients have been diagnosed in the United States alone, that means there could well be 100,000 or more in this country before the end of the decade.

Granted, treatment may very well have improved by that time. But this, too, is unpredictable. A year ago researchers held

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After Fossil Fuels, High-Tech Marketing, and Energy Security

Beyond Fossil Fuels

The Solar-Hydrogen Energy Economy: Beyond the Age of Fire
by Luther W. Skelton
Van Nostrand Reinhold, $29

Reviewed by James J. MacKenzie

Oil and natural gas are the world's primary "energy carriers": these two fuels meet fully 60 percent of global energy needs. However, worldwide production of both fuels is likely to peak within a few decades. Thus, the need to develop alternative energy sources rapidly is profound, though still only dimly perceived by most policymakers. In *The Solar-Hydrogen Energy Economy*, Luther Skelton presents a readable though technically optimistic view of how hydrogen might be introduced as a substitute for oil and natural gas over the next hundred years.

Of course, analysts cannot predict the amounts of recoverable oil and gas resources with absolute certainty. Energy prices and technological developments will help determine how much petroleum and gas are eventually pumped from the earth. Even so, estimates of when supplies will peak are surprisingly insensitive to these variables. Simple calculations suggest that even if global reserves were to increase 30 percent—an amount roughly equivalent to discovering another Middle East—oil and gas resources would peak only six years later than expected.

The production of petroleum, which now meets about 40 percent of world energy needs, will probably turn down first. Within the past five years several analysts have made credible—and similar—estimates of how much crude oil can be recovered. In 1979, Michel T. Halbouty and John Moody predicted that 2,100 billion barrels of oil will ultimately be produced. In 1982, Richard Nehring of the Rand Corp. came up with an estimate of 1,600 to 2,000 billion barrels, with improvements in oil-recovery technology possibly increasing that amount to 2,400 billion barrels. And in 1983 the U.S. Geological Survey put ultimate recoverable oil resources at 1,700 billion barrels.

To try to understand the significance of these estimates, let's assume that 2,000 billion barrels will be recovered. Of this amount, 500 billion barrels have already been produced. If, as happened with U.S.

oil reserves, production peaks about halfway, then supplies will probably begin to decline when another 500 billion barrels have been consumed. This would take about 25 years at 1983's global rate of oil use—19 billion barrels per year. If production rises to 1979's peak rate of 24 billion barrels per year, reserves would be half depleted in about 20 years.

The idea that global oil production could start declining within two decades is a sobering thought indeed. The possible consequences—a rapid bidding up of oil prices with resulting economic, political, and military tensions—would have profound implications for world economic development, not to mention global peace. Yet virtually no one apart from writers in academic and trade journals is focusing on this impending downturn.

Of course, there's a lot of coal around that could be substituted for oil and gas—about ten times more than those two fuels together. Some of this coal can be burned in power plants to produce electricity. But supplying today's vehicles with the energy they are designed to use would require converting coal into synthetic liquid fuel. Consider, though, that replacing just a million barrels per day of oil—about 2 percent of present worldwide demand—with synthetic oil would require building about 20 large synfuels plants costing more than $100 billion. Such an effort would surely strain global funding and construction capabilities. A large-scale effort to produce synfuels would also increase CO_2 emissions, posing serious environmental risks and effectively locking the world into a decades-long high-carbon-fuels experiment.

Biofuels, including alcohols, methane, wood, and trash, could also be used instead of oil and gas. However, they will probably not be available in the needed large amounts, especially in areas where all available land is used to grow food.

A Broad-Brush Approach

The need, then, to develop and introduce new energy carriers not based on carbon is clear. One solution is to convert all transportation and heating systems to run on electricity, which could be produced by either nuclear power or renewable forms of energy. The electricity would be stored in batteries or by other chemical or mechanical means. Another option, favored by Skelton, is to use renewable energy sources to produce hydrogen from water. The hydrogen could be burned directly or used in fuel cells to make electricity, and would be stored as a pressurized or liquefied gas or chemically combined in a metal hydride. Skelton sees renewable technologies—photovoltaics, wind machines, and wave- and tidal-power plants, among others—as the leading candidates for producing the hydrogen. However, although some of these technologies have long been available, their costs must be reduced and reliability increased.

Skelton, a professor in the environmental studies program at Sangamon State University in Illinois, does best in creating a broad-brush conception of what a hydrogen-based future might look like. However, he seems overly optimistic about the feasibility of some renewable technologies. For example, he thinks that "both wave and tidal power should be important sources of water-generated energy." But he doesn't identify any potential sites or estimate either the costs or the amounts of power available.

The most promising solar-electric technologies are wind machines and photovoltaic (PV) cells. More than 700 megawatts of wind turbines will be in operation by the end of this year, mostly in California. And PVs will probably become

ILLUSTRATIONS: KAREN WATSON

economical for a wide variety of uses in a few years. Although hydro dams now provide about 14 percent of U.S. electricity, the prospects for adding large amounts of new capacity are not bright.

How would a mature hydrogen economy evolve? Skelton proposes a very sketchy "model" in answer to this $64,000 question. He focuses on the United States, where a National Energy Corporate Consortium would be formed to invest public funds in research undertaken by both industry and universities. The consortium would "encourage, and if necessary capitalize, new energy corporations with the specific purpose of implementing new technology in the solar-hydrogen area." The consortium would also monitor compliance with national energy goals, which Skelton sets at reducing total energy demand precipitously from the present 70 quads to 50 quads in 15 years, and further to 33 quads in 45 years.

Such a consortium sounds vaguely reminiscent of the Synthetic Fuels Corp., the quasi-government agency set up to help finance synfuels plants. Congress recently slashed funding for this corporation, which has managed to accomplish so very little over the past four years. Skelton does not appear to appreciate the lessons of this experience: that government intervention in energy markets is of limited effectiveness, and that the interplay between government-funded research and private investment is complicated. Of course, investing billions of dollars to produce expensive synthetic fuels is risky today because of the oil glut and reduced oil prices. Converting to a hydrogen economy would be even more difficult because unfamiliar technologies would have to be put into widespread use.

The world's ability to anticipate and react to impending oil and gas shortages that are still two to three decades away seems limited. Perhaps the United States will show the way by increasing its own efforts to develop new technologies for producing and storing energy, and by increasing its reliance on renewables. Despite its technological optimism and political naivete, *The Solar-Hydrogen Energy Economy* is a good introduction for those wishing to understand one possible path our energy future might take. □

JAMES J. MACKENZIE is a senior staff scientist in the Washington, D.C., office of the Union of Concerned Scientists.

Marketers vs. Technical Specialists

Marketing High Technology
by William Shankin and John Ryans
Lexington Books, $24

Reviewed by Alf H. Walle

Norbert Wiener jokes and the "marketing concept" are two artifacts of post-World War II business folklore. These phenomena exemplify the role into which managers and marketers often pigeonhole R&D specialists.

Jokes about Wiener and other high-tech figures both celebrate and degrade the inventors of our modern technological age, portraying technical types as mighty intellects but also as silly Dodo birds who can barely function in the "real world." Although they can create equations that explain the universe, for example, technical specialists are incapable of counting their change in a grocery store. Such jokes reflect the bespectacled "smart-kid" stereotype: being tech-wise is equated with lack of any semblance of street wisdom.

In the same spirit, the marketing concept warns management types to control R&D specialists firmly by focusing their attention on what clients and consumers are willing to buy. R.J. Keith presented the classic statement of this position in "The Marketing Revolution" in the *Journal of Marketing* in 1960. He argued that those directly concerned with satisfying clients' needs, not design and production specialists, should control a business's decision-making process and dictate product design. Although this idea might seem to be just an embellishment of the seller's adage that "nothing happens until a sale is made," Keith's article emerged as a powerful manifesto. The marketing establishment quickly parlayed his slogans into board-room clout, and production and design people emerged as big losers.

Both Norbert Wiener jokes and the marketing concept portray R&D people as Midas figures who can turn everything they see into high-tech gold, but if given their unbridled wish could easily starve us all. After all, neither gold nor mechanical gizmos have any value unless they can be transformed into usable, profitable products. Indeed, one reason for creating the M.B.A. degree was to inculcate engineering types with common sense so they could

better rub elbows with the "good old marketing boys" on the forty-third floor.

The basic assumption of this approach is that both marketer and client realize what needs products can fulfill. However, William Shankin and John Ryans, the authors of *Marketing High Technology*, maintain that the ultimate use of a process or product, especially in high-tech fields, cannot be predicted beforehand. Descartes, for example, invented modern calculus to aim cannons when he was a soldier, but his mathematics has applications for an inexhaustible number of nonmilitary uses. Also, many technologies change so quickly that only the foolhardy assume that clients will immediately comprehend the value of each new product. Thus, the marketing concept might encourage businesses in high-tech fields to steer clear of products that are the wave of the future.

Instead, argue Shankin and Ryans, firms should embrace a product-oriented strategy even if that entails sailing boldly across the current of perceived client needs and desires. Such a strategy should be based on what R&D people have insisted for years: that success often comes only to those who are willing to ride that wonderful, scary, and sometimes treacherous roller coaster that is technological evolution. Marketers who would jump off the roller coaster after plucking some small plum readily demanded by clients risk long-term failure, as products may possess subtle though far-reaching applications easily overlooked in the heat of a short-term marketing campaign. These uses, rather than obvious applications, might constitute the real value of an advance.

For example, the authors observe that "in the field of biotechnology, monoclonal researchers have developed simple, fast, inexpensive diagnostic tests for hepatitis, prostate cancer, pregnancy, venereal disease, and a number of similar conditions. Yet many of the early monoclonal-antibody-based tests did not demonstrate readily apparent advantages. . . . Consequently, the outlook for marketing success was poor." Firms that trusted the classic marketing approach during the initial stages of development of such techniques lost their chance to become leaders in a growing high-tech industry. In these companies, short-term priorities held more sway than long-term potential.

Shankin and Ryans have based their book on interviews with executives in such high-tech fields. Their case studies show that marketers must fulfill different functions in each of three phases of technological progress. Marketers take a back seat during the product-driven stage, when the firm is organized around R&D priorities and seeks to earn legal protections such as patents to insure competitive advantage. R&D continues to have priority during the supply-driven stage, but marketers have a vital role in introducing the advantages of products to clients who do not perceive them as particularly useful. Sales personnel often take orders from technical specialists and may even have considerable technical knowlege themselves. In the final, demand-driven stage, clients better understand the technology and make sophisticated requests, which the sales staff must relay to the R&D department. Of course, determining when a product enters its stages can be difficult.

All marketers should incorporate the book's message into their dealings with R&D specialists. Until they do, technical employees should use the ideas as board-room ammunition when dealing with old-style demand marketers. □

ALF H. WALLE is assistant professor in the Marketing Department of the University of Akron in Ohio.

Enhancing Energy Security

Brittle Power
by Amory and L. Hunter Lovins
Brick House, $19.95

Reviewed by Irvin C. Bupp

The society in which we live and work is extremely fragile, as anyone who has been trapped for hours on an expressway because of a minor traffic accident or suffered through an electricity blackout can attest. We are vulnerable to inconvenience and even grave danger, to say nothing of economic loss, from failures of the complex interconnected systems that control our daily activities. In *Brittle Power*, Amory and L. Hunter Lovins confront the vulnerability of the systems that provide our energy: central-station power plants; high-voltage, long-distance electric-transmission grids; oil and natural-gas pipelines; and natural-gas liquefaction and transportation facilities. The authors contend that these energy supply systems are based on "misapplied technologies," as all are egregiously vulnerable to disruption by accident, natural disaster, or sabotage.

The authors maintain that the vulnerability of these systems is largely unnecessary. A number of alternative technologies either already exist, or can cheaply and quickly be developed, that are both less expensive and more resilient than the systems in widespread use today. The Lovinses buttress their claims with a daunting array of detailed references to practical experience with R&D on alternative energy technologies, both in the United States and abroad. This encyclopedic catalogue may be the book's most important contribution.

Strange Bedfellows

Brittle Power carries strong endorsements by a former chairman of the joint chiefs of staff, a senior Republican U.S. senator, and the former director of the Solar Energy Research Institute. This range of praise suggests that the book is a significant practical achievement. The Lovinses have forged a link between the conservative national-security establishment and liberal critics of conventional energy technologies, especially nuclear power. The former have found the authors articulate and witty publicists for concerns usually promoted by a few specialists in academia and government. Critics of nuclear power and advocates of alternative energy technologies have been given a way to enhance the popular appeal of their claims by citing potential contributions to national security. For the Lovinses make a strong case that by moving toward the now-familiar "soft-path" energy technologies—passive solar, small-scale hydro, wind, insulation, and photovoltaics—the United States can significantly enhance its military preparedness.

Are they right?

In principle, yes. Building new central-station nuclear and coal-fired plants is clearly the most expensive and least reliable way to add capacity for generating electricity. Conserving energy and improving the management of resources are the least expensive and most reliable ways to create new capacity. Most of the other alternative technologies fall between these two extremes. However, although the Lovinses are right that decentralized energy technologies are less vulnerable, the practical benefits of moving toward less centralized energy production would not be as clearcut as they maintain.

Still, my reservations about *Brittle*

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The Politics of Starvation

BY NEVIN S. SCRIMSHAW

By World Bank estimates, at least 800 million persons in developing countries have a diet so limited they do not have the energy for routine physical activities. The World Health Organization (WHO) estimates that another 300 million children are retarded in growth and mental development and at increased risk of disease and death as a result of malnutrition. In some of the poorer countries in Africa, Latin America, and Asia, 70 to 80 percent of the children are growing up with their genetic potential for growth and development impaired and their health compromised. Even in countries that have made some progress in reducing hunger, such as India, Indonesia, the Philippines, Colombia, and Brazil, the majority of preschool children has lower-than-normal growth curves or weight for age. China has all but eliminated overt clinical malnutrition among its children, but chronic undernutrition still greatly reduces growth and development among some segments of its population. Even in the United States, surveys by the Department of Health and Human Services show a lower-than-normal growth rate among children of underprivileged and minority groups. Malnutrition obviously is a problem that cannot be solved by economic development alone.

UNICEF's annual report for 1982-83 says that every day more than 40,000 young children die of malnutrition and infection, and "for every one who has died, six now live in hunger and ill health which will be forever etched upon their lives." According to the U.N. Food and Agriculture Organization (FAO), a continuation of present economic trends in many developing companies will result in "a horrifying increase in the numbers of seriously undernourished children in the world."

Apart from our obvious humanitarian obligation to help those less fortunate than ourselves, there are other reasons to fight widespread hunger and malnutrition. Countries with large populations whose physical and mental capacities are impaired because of malnutrition are less likely to meet their goals for economic development. Continued failure in economic progress sows the seeds of dissension and revolt, and indeed is a primary cause of the social and political instability we see in so many developing countries today. If those nations cannot adequately feed their people and control their rapid population growth, the gap between the "haves" and the "have-nots" will widen, with dangerous consequences for world stability.

Poor people are hungry or malnourished either because they are not able to obtain enough food of the right kind, or because they don't know

To eliminate widespread hunger, developing countries must carry out far-reaching land reform and provide better health care and education for their poor.

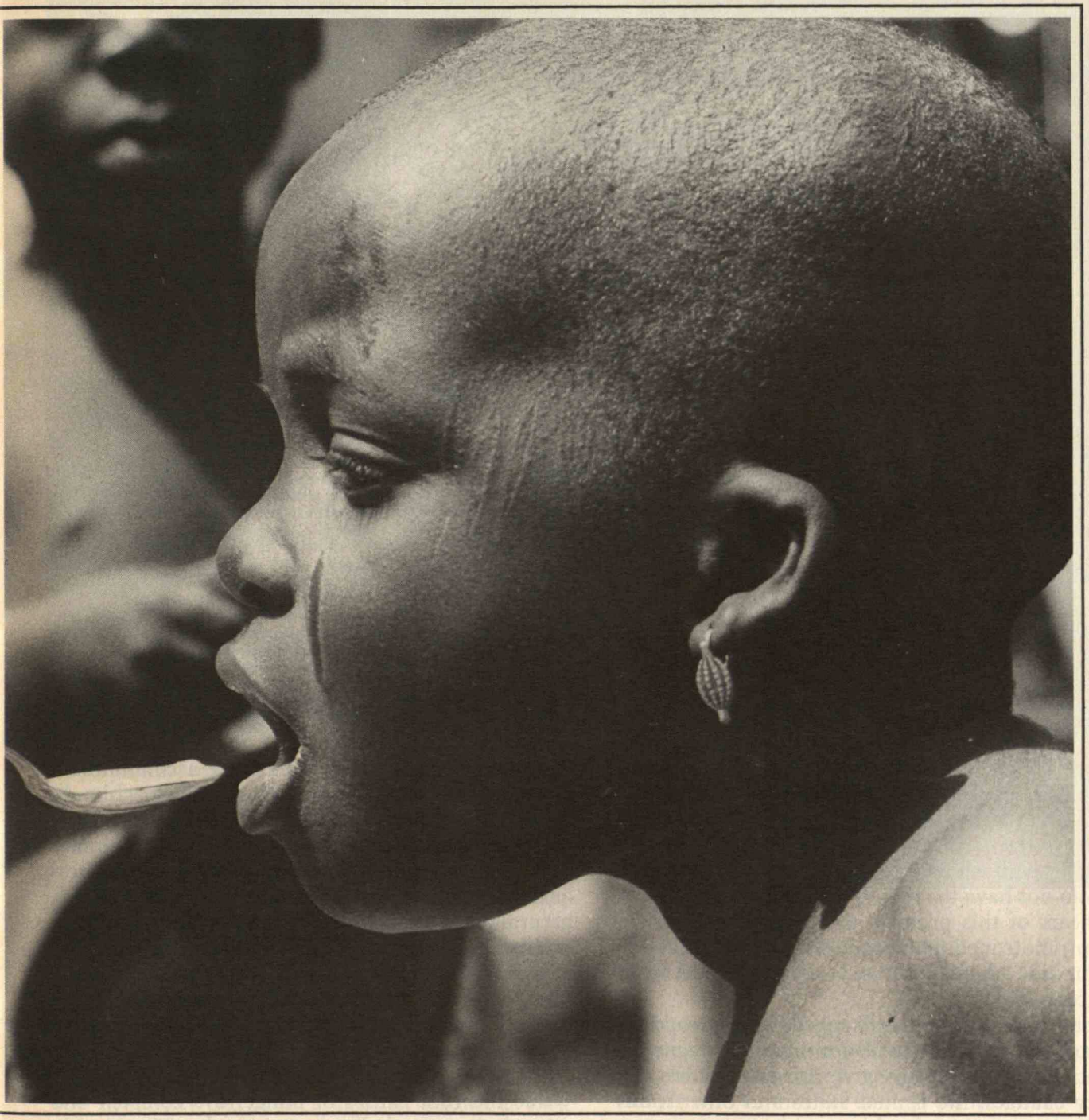
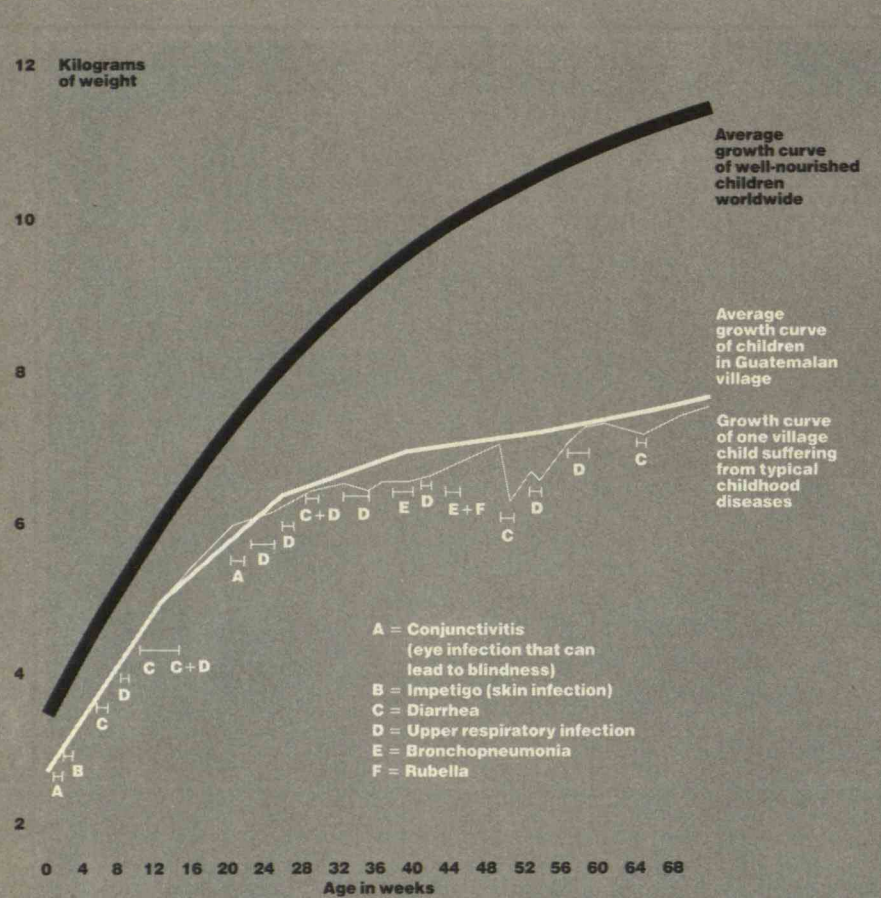


PHOTO: CARLO BAVAGNOLI, BLACK STAR

Right from birth, the children of lower-income populations are at a severe disadvantage.



Malnutrition and infection are a double-edged sword in many developing countries, retarding the physical and mental growth of children. The graph shows the lower-than-average growth curve of impoverished children in a Guatemalan Highlands village, compared with the average growth curve of well-nourished children worldwide. The thin line represents the growth of one child suffering from typical village diseases. Regular weigh-ins can be used to identify infants who are sick or poorly nourished (photo).

enough about the nature and importance of an adequate diet. In most developing countries, the amount of food being produced is not the limiting factor. Rather, large portions of the population do not have access to land where they can grow enough food, or they do not have the money to buy enough food. At the heart of this problem are government policies that promote inequitable land tenure systems and do not provide adequate access to education and health services.

Until these policies are changed, widespread hunger and malnutrition will continue to plague the countries of the developing world. To expedite such policy changes, the United States and other industrialized countries should provide generous economic and food aid only to governments that try to improve domestic food production and distribution, as well as increase their citizens' access to education and health. We should withhold aid from governments unwilling or unable to make a commitment of this kind. That is not to say such countries should be written off; they can still be helped on a project-by-project basis, particularly at the local community level. And foreign food subsidies are essential in relieving the genuine food emergencies that result from natural disasters, war, and civil disturbances. Today such aid is easing the hunger of refugees fleeing from Afghanistan into Pakistan, from Cambodia into Thailand, and from Guatemala into Mexico.

The Consequences of Hunger

While the root causes of hunger are complex and difficult to erase, the final nutritional results are easy to identify—and devastating. Right from birth, the children of lower-income populations in developing countries are at a severe disadvantage. They tend to have a low birth weight and reduced nutrient re-

PHOTO: CARLO BAVAGNOLI, BLACK STAR; DIAGRAM: OMNIGRAPHICS

Every day more than 40,000 young children die of malnutrition and infection.

serves because their mothers are poorly nourished. While most of these infants are breast fed and do well during their first few months, by four to six months breast milk alone is no longer sufficient and growth begins to falter. Such early malnutrition reduces these infants' resistance to infection, and they are constantly exposed to diarrhea and other diseases that deplete their nutritional reserves. If they are not given adequate food to complement breast milk they may die. Even if these children survive, early malnutrition can permanently impair physical and mental development. Nearly two-thirds of all children in most developing countries suffer some degree of protein-calorie deficiency.

In some populations, particularly in urban areas, the need for mothers to work, along with misguided advice from health workers and commercial promotion of bottle feeding, have reduced the frequency and duration of breast feeding with even more adverse results. When breast feeding is abandoned early and solid food is grossly inadequate, the result is nutritional marasmus, a form of slow starvation. This is a serious problem in northeast Brazil and a number of other South American countries, as well as in most African cities and the Sahel region of western Africa.

Determined efforts to restrict the promotion of infant formulas and encourage breast feeding have been strikingly effective in some countries. In Bahrain, one of the small oil-rich states of the Persian Gulf, breast feeding was rapidly decreasing because of modernization and intensive promotion of infant formulas. Adoption of the "WHO Code on the Marketing of Infant Formulas," which prohibits direct advertising and promotion to the public, together with vigorous education, reversed this trend, raising the proportion of women breast feeding their children from 25 to 75 percent in less than three years. The major international distributers of infant formula (including the Nestlé Co.) have recently agreed to abide by this code, which should be helpful if the health sector also promotes breast feeding.

In many cases, infants not being breast fed are mainly given carbohydrates, and the resulting protein deficiency can cause a disorder known as kwashiorkor. The symptoms are edema, hair that is thin and easily pulled out, profound apathy, loss of appetite, and diarrhea. The liver becomes fatty and organs atrophy, infections frequently result, and the victim dies unless supplied with adequate food.

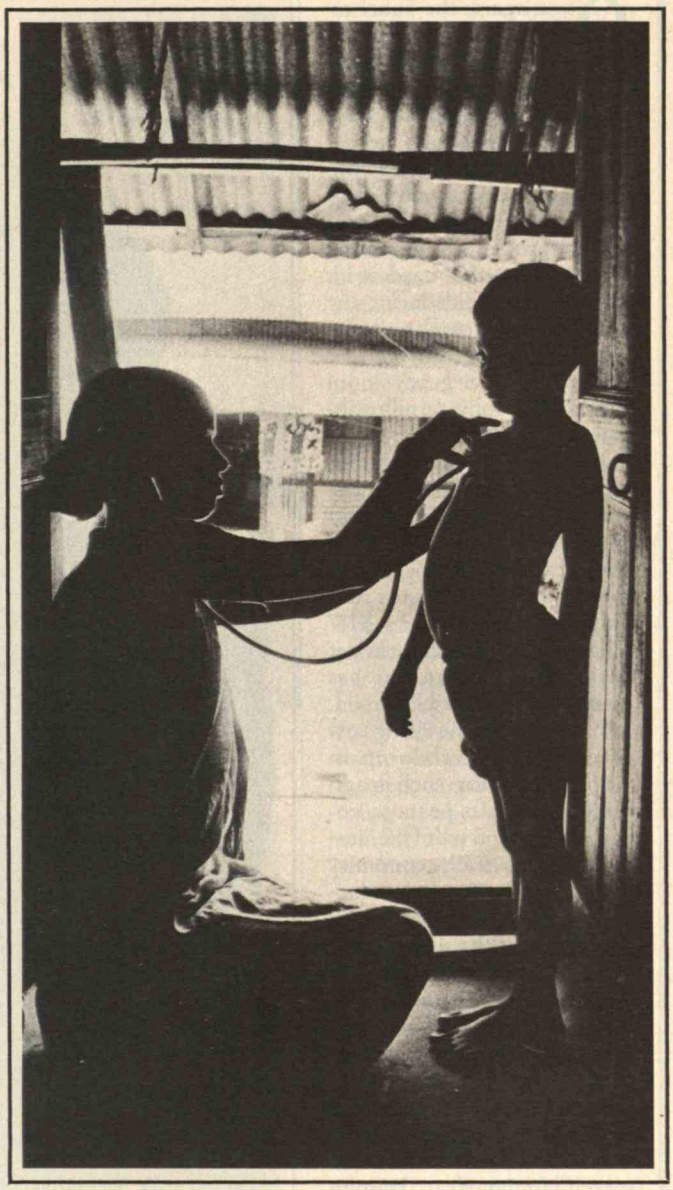


PHOTO: BOSTON GLOBE

The Listless Poor

In many areas of the developing world, people's basic caloric intake is below normal, and the result is a chronic deficiency in energy. To survive, individuals who cannot get enough calories must reduce those activities that are not absolutely essential for day-to-day survival. Yet "discretionary" activities such as planting a garden, walking to community meetings, and maintaining the home help improve

(Continued on page 24)

Hunger in West Africa: A Crisis in Development

BY JOHN WALSH

ONCE again, the Sahel region of western Africa is in the grip of widespread famine and drought. Two years of inadequate rainfall have decimated livestock herds, turned productive land into desert, and cost thousands of people their lives. International agencies are providing food aid to the hardest-hit areas, as they did during the last severe drought of the early 1970s. But beyond the immediate emergency loom formidable long-term problems of development.

For the last two decades, population growth in the countries of western Africa has been outrunning increases in food production. Despite foreign assistance that is running at a level of nearly $1.7 billion a year, a decline in per capita food production has become an established trend. In recent years, the rising cost of energy and a slump in world prices for such traditional exports as peanuts, cocoa, coffee, and palm oil have battered the frail economies of the region, further reducing its capacity to deal with the effects of the drought.

Faced with such alarming trends, international assistance agencies have been reevaluating their development strategies for Africa. World Bank Vice-President Ernest Stern made one of the more candid assessments in a speech last January. "Despite all our achievements, I think it is fair to say we have failed in Africa along with everybody else," Stern said. "We have not fully understood the problems. We have not always designed our projects to fit the agroclimatic conditions of Africa and the social, cultural, and political framework of the African countries."

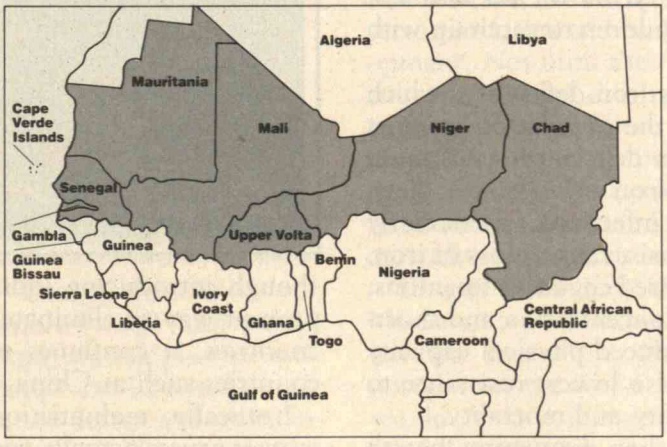
Sahel, an Arab word for coast or border, denotes six former French territories on the fringes of the Sahara—Senegal, Mauritania, Mali, Niger, Chad, and Upper Volta—along with the Gambia and the Cape Verde Islands. When these countries gained independence in the 1950s and 1960s, their governments generally reacted against the colonial past by enacting highly nationalistic and centralized policies. These policies typically favored urban industrial development at the expense of rural agriculture.

"For every child who dies, six live on in hunger and ill health that will be forever etched upon their lives."

International aid largely reinforced that model of economic development. The World Bank and other organizations heavily supported major capital projects such as highways, railroads, dams, power plants, and port facilities. Agriculture was neglected, and there was a massive movement of rural people to the cities. With the disruption of traditional cultural patterns and urbanization came a rapid growth in population, which continues today. The population of the Sahel, now about 32 million, is increasing at an estimated 2.7 percent a year, compared with an average 1.5 percent increase in food production. Yet cultural and political attitudes have largely prevented even public discussion of population-control measures.

These problems were exacerbated by a drought that has persisted with varying intensity since the late 1960s. The continued plight of the Sahel in the 1970s forced "donor" agencies to alter their development strategies in the region. As early as 1973, Robert McNamara, then president of the World Bank, announced that the bank would concentrate less on major capital projects and more on "rural development" programs designed to boost

Two years of severe drought in the Sahel have decimated livestock herds, turned productive land into desert, and cost thousands of people their lives. The afflicted region includes the six African countries on the south-southwestern fringe of the Sahara Desert—Senegal, Mauritania, Mali, Niger, Chad, and Upper Volta—along with the Gambia and the Cape Verde Islands.



food production and directly aid the poorest people in the poorest countries. McNamara noted then that the "trickle-down" effect implicit in the conventional development strategy was simply not working in the Sahel.

The Community Approach

The new strategy, however, has encountered difficulties. In some ways, grand-scale infrastructure projects were easier for both donors and recipients to carry out. Building a four-lane highway or an airport did not require the detailed knowledge of an area's traditions and conditions that is essential to the success of a local project. Nor did it demand the cooperation of government officials at all levels, as well as of the local people themselves. Also, while large-scale projects are often one-shot capital investments, the type of agricultural, health, and education projects that most directly benefit the rural poor require continuing financial support as well as trained people to keep them running. For all these reasons, establishing a successful system of rural clinics, for instance, may be harder than building a central hospital.

Donor organizations have increasingly blamed the lag in agricultural development on the domestic policies of the Sahel governments. Quasi-governmental agencies called parastatals have come under particularly heavy criticism. In agriculture these agencies, which exercise monopoly control over consumer and producer prices, have typically kept farm crop prices low. Such a policy subsidizes food for urban dwellers but deprives farmers of incentives to venture beyond subsistence agriculture.

The World Bank and other international agencies are now attempting to foster changes in domestic policy by making financial assistance conditional on reform. They are asking the Sahelian governments to devalue their local currencies to reduce imports and encourage exports, increase consumer food prices, and relax centralized controls. The U.S. Agency for International Development (AID) is also stressing the principle of "conditionality" in its new $500 million program of bilateral assistance for Africa over the next five years.

However, regional self-sufficiency in food production cannot be achieved by political reforms alone. The most serious threat to food production in the Sahel is "desertification," the gradual process of environmental degradation. The most familiar type of desertification is the expansion of sand dunes, and the Sahara's seemingly inexorable advance over once-productive farmland is a powerful symbol of the Sahel's plight. But a larger problem is the erosion of marginal farmland because of overgrazing or poor agricultural practices. Before local governments can effectively fight these problems, they must have a better understanding of the Sahel's climate and ecosystem. More research is needed on agroforestry, water resources, dune stablization, and the parasitic diseases that plague this region.

Slowing Population Growth

The major increases in food production that occurred in parts of Asia and Latin America during the 1970s are attributed to irrigation. But such conditions cannot easily be reproduced in the Sahel because of the lack of regular rainfall. Yet plant breeders are far from developing high-yielding crops that are capable of resisting disease and the long periods of drought typical of the Sahel.

The most intractable problem of all is population growth. Some responsible commentators forecast a Malthusian denouement in the Sahel, unless effective birth-control measures are instituted or the population levels off naturally. A report on development prospects by the U.N.-related Economic Commission on Africa grimly suggests that under an "historic trend scenario," by the year 2008 "socioeconomic conditions would be characterized by a degradation of the very essence of humanity." □

JOHN WALSH is a staff writer for the News and Comment section of Science.

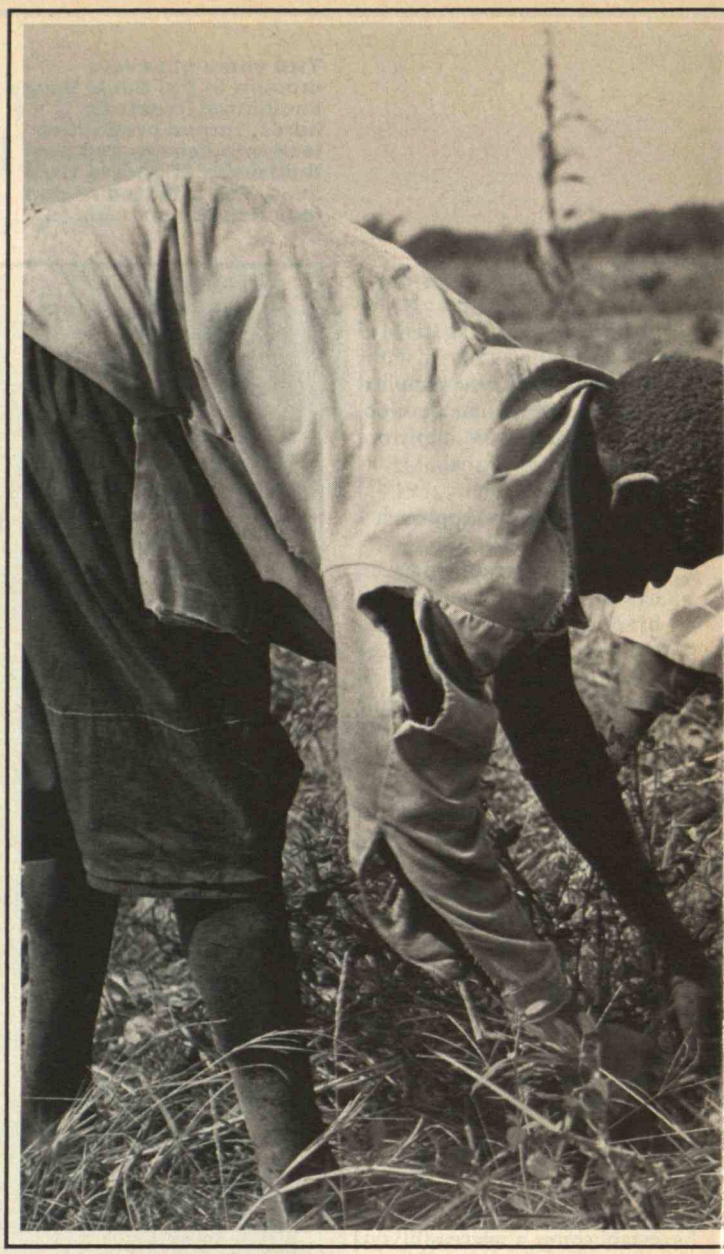
PHOTOS: UNITED NATIONS; MAP: OMNIGRAPHICS

family welfare and community development.

For children, reducing physical activity means they receive less stimulation than needed for normal cognitive development. In Tlaltizapan, Mexico, health workers noted that the children were listless, apathetic, and interacting minimally with other people and the physical environment. When these children received a daily food supplement, they became more active, began to play with other children, and, by getting into mischief, attracted the attention of parents and older siblings. The positive effect of improved nutrition and increased activity on intellectual function has also been shown in Cali, Colombia. There children from the urban slums were provided with one, two, or three years of an improved diet combined with active play and stimulation. Their performances on a battery of tests were then compared with those of slum children who did not take part in the program, and with those of a group of children from middle- and upper-income families. The result was improved cognitive performance proportional to the number of years in the program. However, even three years of aid was not enough to enable the slum children to catch up with their more privileged peers.

Another major problem is iron deficiency, which affects about two-thirds of the population in most developing countries. Such a deficiency is common because there is not much iron in vegetable diets, and because a number of infections, particularly hookworm and schistosomiasis, cause a loss of iron. Iron deficiency leads to impaired cognitive functions, particulary those involving concentration and short-term memory, as well as reduced physical capacity and work performance. It also lowers resistance to infection, increasing morbidity and mortality.

Iodine deficiency is another disturbing health problem in the developing world. When the food and water supply fails to provide enough iodine, people's thyroid glands swell to capture more iodine from the circulatory system. This thyroid enlargement, termed endemic goiter, is still widespread in many countries, and afflicts as much as 80 percent of the population in the more mountainous areas of Latin America, Asia, and Africa, where the soil does not contain much iodine. Children who have severe cases of endemic goiter may even be born as feeble-minded dwarfs called cretins. Less severe cases of iodine deficiency cause deafmutism and mental impairment in a much larger number of people. Although introducing iodized salt into the diet is a prompt way to eliminate iodine deficiency in many countries, it continues to be a major problem in countries such as China, Indonesia, and India.



Ironically, malnutrition and the increased mortality it causes actually contribute to the dangerously high rates of population growth in many developing countries. Parents who expect high death rates among their children, and who depend on them for labor and assistance in old age, do not readily accept family-planning measures. Yet developing countries must bring down their birth rates if they are to have any chance of providing all their citizens with an adequate food supply.

Food Aid with Strings Attached

For the last three decades, our response to hunger in the developing world has been governed by two

largely erroneous beliefs. One is that economic growth will eventually "trickle down" and reduce poverty, ill health, and hunger among poor people. The other is that chronic hunger can be cured simply by supplying food. The United States and other industrialized countries have poured billions of dollars in economic and food aid into the developing world based on these principles.

Most of the assistance from the U.S. has taken the form of food aid. The original "food for peace" program was launched in 1954 primarily to dispose of troublesome food surpluses in a politically attractive way. Even though the American public perceives food aid in largely altruistic terms, the truth is that the largest proportion is allotted on the basis of "strategic considerations" rather than need. From 1970 to 1979, for instance, 34 percent of "food for peace" went to four strategically important countries—Vietnam, South Korea, Israel, and Egypt.

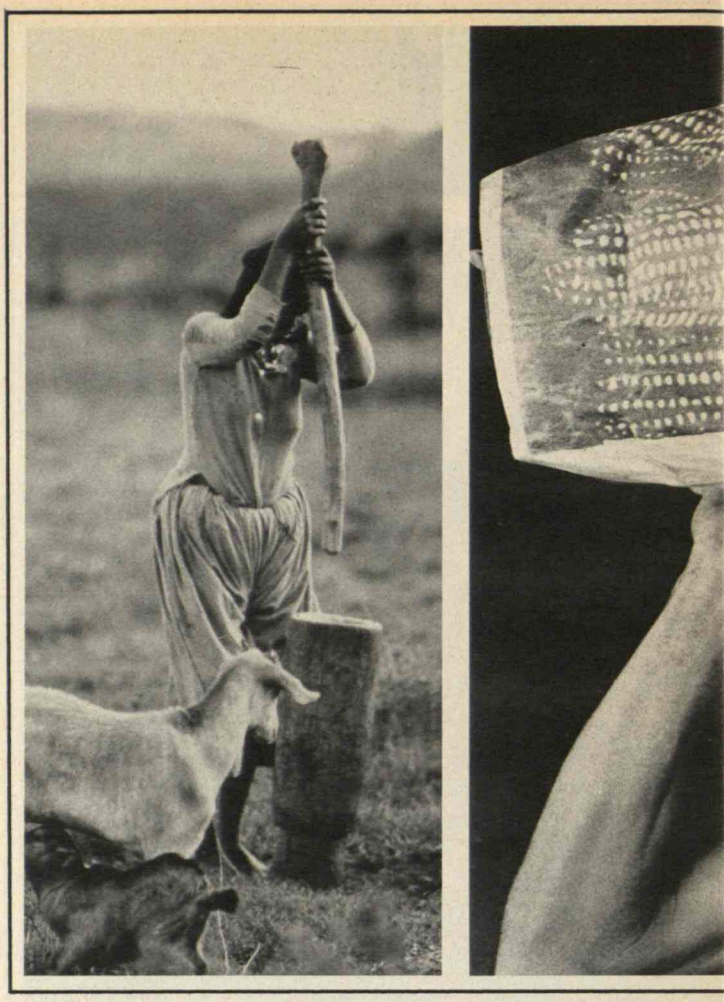
In most developing countries, the drive for urban and industrial development has come at the expense of the small rural farmer.

Surprisingly few foreign aid dollars actually reach the poor. For example, for years, U.S. food assistance to the Philippines was routed through top government officials and dispensed through the public schools to schoolchildren. However, much of that aid, in the form of powdered milk and flour, disappeared before it reached the schools; some observers say it was distributed in exchange for political favors or sold at a profit. The U.S. government abruptly withdrew its aid when President Ferdinand Marcos refused to abide by certain demands of the U.S. State Department. Today food assistance still reaches the Philippines, but it goes directly from the U.S. Catholic Relief Service, a nongovernmental agency, to the Catholic Relief Service in Manila. The hope is that more of the food will reach Manila's urban poor.

Aid from the United States and other industrialized countries may actually be counterproductive when substituted for national efforts to improve food production and distribution. For instance, massive amounts of subsidized grain from the United States in the 1960s enabled India to neglect its rural sector in favor of heavy industry and urban development. Not until the relationship between the two countries cooled did India begin to reform its agricultural policies. These relatively simple changes included raising crop prices to stimulate farmers to produce more food; assisting farmers to buy seeds, fertilizers, and pesticides on credit; and investing in agricultural research and extension services.

Despite some individual success stories, the trickle-down theory of domestic economic development has also failed. The 1970s, for instance, were supposed to be the decade during which many countries would make substantial progress toward building the infrastructure of a modern economy. Toward that end, organizations such as the World Bank heavily funded major capital projects such as highways, railroads, dams, power plants, and port facilities. But in most developing countries, this drive for urban and industrial development came at the expense of small rural farmers. Food prices were kept artificially low to benefit the more politically vocal urban sector, and investments in agricultural research, fertilizer, seeds, and pesticides were neglected. Many of the rural poor migrated to already overcrowded cities, causing massive urban poverty and underemployment. At the same time, the elite appropriated most of the rewards of economic prog-

PHOTO: RAY WITLIN, WORLD BANK



ress for themselves. In Mexico, for instance, irrigation subsidies went mainly to large farmers and corporate farms.

Governments That Care

Some developing countries have made notable progress in eliminating hunger and malnutrition. China, with an arable land mass no greater than that of India, has managed to feed a population four times greater and provide good health services as well. Taiwan, Costa Rica, Korea, Singapore, Hong Kong, and Cuba are also doing well, and a number of other countries such as Indonesia, Malaysia, Thailand, Colombia, and Chile are making good, if somewhat uneven, progress. Progress in countries such as India, Pakistan, and Egypt has slowed because of internal economic and political problems. Although Sri Lanka, and to a lesser extent Tanzania, made outstanding progress in the 1960s and 1970s, they are now experiencing serious economic difficulties, partly because of increased oil prices. However, their long-term prospects are good if they can maintain sound government policies.

The principal factor behind every one of these success stories is a government that, regardless of its ideological base, cares about its people and has given priority to education and health. Government officials in these countries specifically aim goods and services, including health care, housing, systems for water supply and sewage disposal, education, and welfare activities, toward their poorest people.

For example, in 1960, infant mortality rates were 60 per 1,000 in Costa Rica and 92 per 1,000 in Guatemala, compared with 26 per 1,000 in the United States. For children 1 to 4 years of age, the mortality rates were 28 per 1,000 in Costa Rica, 32 per 1,000 in Guatemala, and 1 per 1,000 in the United States. As recently as 1966, 14 percent of preschool children in Costa Rica suffered moderate to severe malnutrition. Both kwashiorkor and marasmus were widespread. By 1982, malnutrition among Costa Rican preschoolers was less than 5 percent. Infant mortality had dropped to 17 percent and preschool mortality to 1 percent, figures comparable with those of North America and Europe. But the situation in Guatemala did not improve.

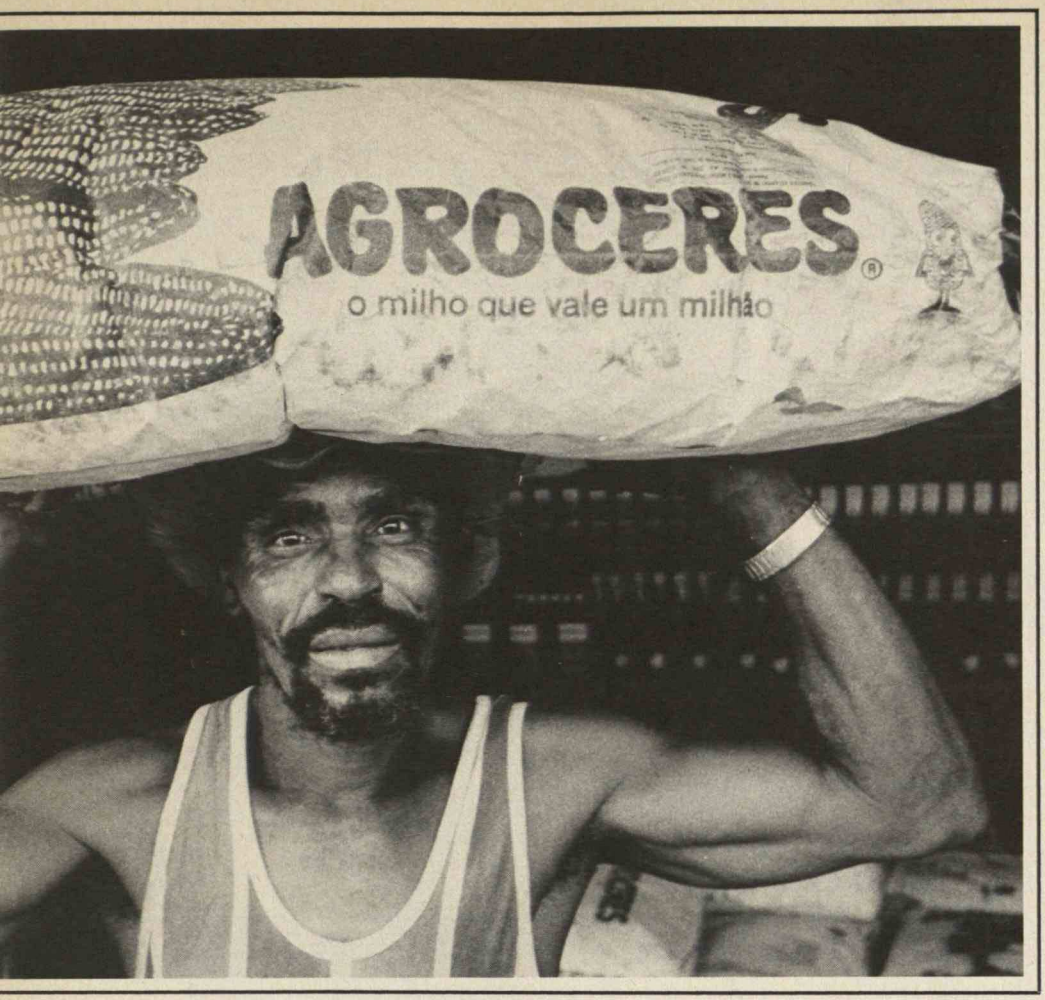
What made the difference in Costa Rica was a government policy devoting a major proportion of the national income to education and health. The national army was disbanded, and the wealthy were heavily taxed to fund services to the poor.

Nicaragua is placing the same emphasis on social services as Costa Rica. Endemic goiter, for instance, was eliminated by the late 1970s in most Central American countries—except in Somoza's Nicaragua. After Somoza was overthrown, the new government iodized all salt for human consumption as one of its first health measures. Nicaragua is also trying to increase the number of small farms, limit the size of large farms, and give small farmers advice and access to subsidized seeds, fertilizers, and pesticides.

Other countries with differing political ideologies but the same goals—such as Egypt, Peru, Taiwan, and, much earlier, Mexico—have managed to carry out far-reaching reforms in land ownership. These governments have also tried to ensure that those without land have the means to purchase food. In Egypt, for example, bread is subsidized as a major hedge against severe undernutrition. As a similar hedge, the countries of the Asian subcontinent—India, Pakistan, and Bangladesh—have instituted fair-price shops, where essential staples are sold at reduced prices to needy families.

Turning from the successes to the failures, we find a similar diversity of political systems. Ghana, Ni-

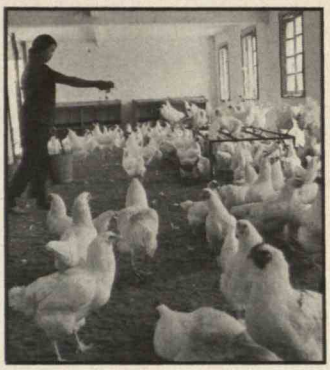
PHOTOGRAPHIC RESEARCH: SUSAN ELSNER



Regardless of ideology, countries with governments that care about their people have made progress in eliminating hunger.

Communist China, with an arable land mass no greater than that of India, feeds a population four times greater. A Chinese woman (inset) feeds chickens for human consumption. Capitalist Brazil is feeding its people by offering agricultural subsidies and incentives. A Brazilian farmer (center) carries away his quota of millet.

Malnutrition is as much of a problem in capitalist El Salvador as in Marxian Ethiopia. Far left: An Ethiopian woman pounds maize in the drought-stricken region of Bale.



geria, Bolivia, Paraguay, El Salvador, and Guatemala are all capitalist countries where the quality of life either is not improving or is actually regressing. The same is true in the Marxian socialist countries of Ethiopia, Mozambique, and Angola. The nations unable to eliminate chronic hunger and malnutrition have a common characteristic: protection of the status quo, usually by an elite class bent on preserving its economic and social privilege without regard for the general population.

Wages and taxes are kept low in many of these countries to benefit land and business owners, who invest much of their profits in foreign real estate and banks instead of in their own countries. Furthermore, the land tenure system is so inequitable that it maintains a permanent underprivileged and undernourished class. For example, with 2 percent of the population controlling 80 percent of the agricultural land, El Salvador has the largest proportion of landless rural laborers of any country in the world. Yet the power groups that have always dominated El Salvadorean governments—the large land and business owners and their military supporters—have totally resisted any meaningful land reform. They have also blocked basic public-health measures and housing assistance. The recent election of Jose Napoleon Duarte will not make much difference as long as U.S. policy allows these traditional power blocs to resist needed reforms.

The situation is little better in neighboring Guatemala. There 80 percent of the fertile agricultural land is in the hands of a few large landowners, and rural unemployment exceeds 30 percent. Yet negligible real-estate taxes allow this elite to leave its land idle without serious penalty. On Guatemala's Pacific coast, exceptionally fertile volcanic soils are used for large cattle farms that produce meat primarily for export. If these lands were used instead for labor-intensive crops, rural employment would greatly increase, reducing poverty and chronic malnutrition among the country's landless.

National and multinational companies have only exacerbated these problems in both Guatemala and El Salvador. Companies such as United Fruit have joined with the elite in resisting social and political reforms. And U.S. financial aid has changed the status quo very little in these countries. In El Salvador, at least, such assistance is far more likely to be used to purchase apartment houses in Miami or to buy military supplies than to help the poor.

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PHOTOS: F. MATTIOLI, A.F.O.; YOSEF HADER AND RAY WITLIN, WORLD BANK; LOUISE GUBB, U.N.

New devices used to better the achievements of elite athletes are now becoming available to improve the fitness of weekend sports enthusiasts.

Technology, Health, and Human Performance

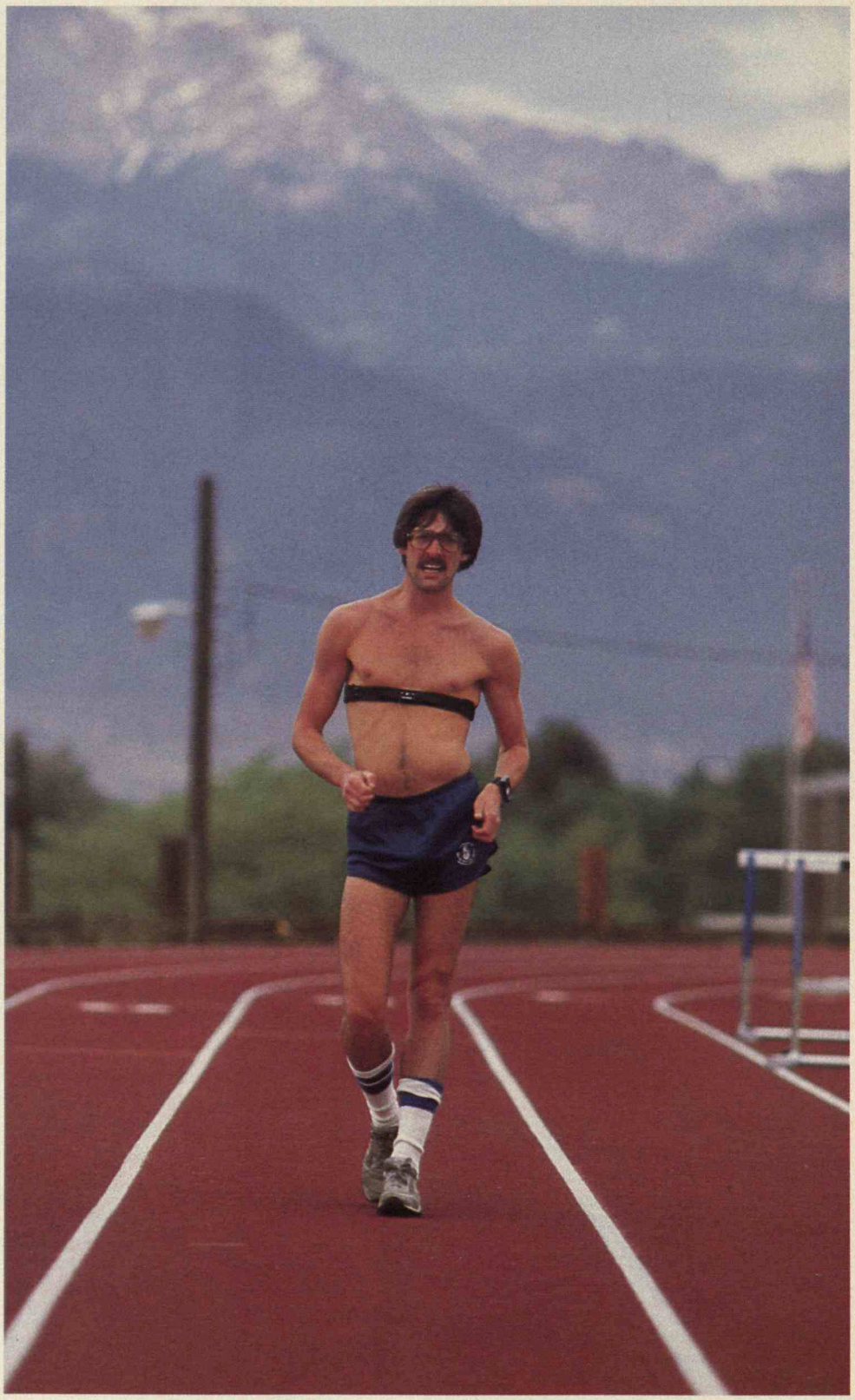
BY ROBERT O. VOY

DURING a particularly tough workout this spring, one of the key members of the U.S. team handball squad injured his knee. Five years ago the injury would automatically have kept him out of action for the rest of the year, because he would have required major surgery simply to diagnose the ailment. But by using arthroscopy, a form of surgery that involves only a tiny incision and causes minimal trauma, a surgeon was able to diagnose the condition as a minor one: a partial tear of the cartilage known as a meniscus. The player was put on an intensive rehabilitation program using machines designed to bring athletes back to 100 percent fitness fast, and he was back on the handball court within ten days. He will be a key member of the U.S. team at the Los Angeles Olympics.

Early this year, an experienced U.S. marathon runner suffered repeated foot injuries that severely restricted his ability to train effectively. The runner suspected that his left foot was severely pronating—that is, swinging around at the heel more freely than necessary, and thus causing damage to his ankle. But he couldn't tell when the pronation was occurring. To help him, biomechanics personnel at the U.S. Olympic Training

High technology at the U.S. Olympic Training Center reveals a pole vaulter in action. Stick figures are obtained by digitizing frames of high-speed film (bottom). The process helps vaulters to perfect their style.

PHOTOGRAPHS: JOHN MORGAN



Elite athletes demand biomechanical aids that are portable and noninvasive, enabling them to perform in circumstances as close to real competition as possible. The electrodynogram (above) provides sensitive measurements of the pressures on the feet of runners and race walkers. Sensors glued to the soles of the feet link up to a data collector on the athlete's waist. The heart-rate monitor (top and right) gives athletes real-time readouts of their heart rates during training sessions.

Equipment used to improve athletes' efficiency guarantees that many of this year's Olympians will break records.

Center in Colorado Springs attached small light-emitting diodes (LEDs) to his heel and the area around his achilles tendon. Using film sensitive to the infrared light emitted by the LEDs, the medical team then took high-speed film as he ran. The spots of light showed the changing angle between the runner's calf and foot. This information, interpreted by his trainers, enabled him to adjust his stride to avoid the pronation and stay clear of injuries in the months leading up to this year's U.S. marathon trial. He didn't make the Olympic team, but his high finish would have been very unlikely without the intervention of sports technology.

This Olympic year, technology is more influential than ever in helping the world's best athletes achieve the maximum performances of which their bodies are capable. New devices that improve athletes' efficiency, reduce their risk of injury, and speed up the healing process when injuries do occur guarantee that this year's Olympians will often exceed their personal bests and probably break Olympic records. But the benefits of sports technology don't end there. The new machines and techniques are rapidly becoming available to evening softball players, lunch-hour joggers, weekend tennis players, and a host of other part-time participants in recreational sport. Equipment designed to improve the already superior performances of elite athletes is therefore leading to a general gain in the all-round fitness of ordinary Americans.

Machines can't do it all, for Olympians or casual athletes. Using technology to produce a body in peak condition demands the combined efforts of a motivated individual and an experienced physician or trainer. Motivation is especially critical for elite athletes. While weekend joggers undertake minor mental struggles to get out of a warm bed on a cold Saturday morning, the dedicated athlete must often give up family, formal education, and many other semblances of normal life for at least two years to undergo the rigorous training that is available only at institutions such as the Olympic Training Center. They must also be prepared to endure the enormous agony of defeat. One American weight lifter, for example, spent two years at the center trying to improve his lifts by the 20 pounds necessary to equal the world record for his weight class. He failed.

Recreational athletes don't have to worry about those particular traumas. But they should learn about the type of rudimentary sports technology that the best athletes have long regarded as essential. Taping up vulnerable joints such as ankles before exercise, stretching at the beginning and end of workouts, and using ice massage and baths after exercise to reduce inflammations of tendons and ligaments and the attrition of joints are advisable for any sports enthusiast. The scale is also a vital piece of equipment for every athlete. By weighing yourself before and after every activity, you can determine how much fluid you have lost and replace it by drinking water or electrolyte mixtures, at a rate of one pint per pound of loss. On a hot, humid day, it's easy to lose five pounds in three sets of tennis.

But the real news in sports medicine is the emergence of new devices, based mainly on electronics, that can provide specific feedback on performance for athletes straining to improve their skills or come back after injury. The new machines, such as LED systems, Orthotrons, and electrostimulators, appeared originally in university athletic departments and national training facilities. But now these devices can be found in health clubs and orthopedists' offices.

Instant Feedback

Ready availability is one advantage of the new devices of sports medicine. As they become smaller and acquire more artificial intelligence, these machines offer other advantages as well. Many are non-invasive, working without risking the athlete's health. Almost as important, some of the devices enable athletes to perform their specialties—swimming, jumping, and basketball, for example—under true competitive conditions without the impediment of wires. Portable machines can be mounted on the track, pool, or court, allowing athletes to work in their natural surroundings rather than the cramped confines of the laboratory. Finally, several of the new devices give instant feedback. That's an important inducement for athletes who want to work out errors in their style as soon as they are detected.

The shift from film to video at the Olympic Training Center shows how developing technology is improving the ability of athletes and their trainers to diagnose rapidly any problems that might hold back performance or cause injury. Biomechanicists seeking to learn the most efficient ways of carrying out different athletic tasks have traditionally relied on high-speed film, generally in the range of 100 to 200

Sports physicians increasingly rely on technology to help them in diagnosing ailments and setting up rehabilitation programs.

frames per second but sometimes up to 1,000 frames per second. Careful studies of individual frames yield useful general hints about an athlete's style. But to gain numerical data, the film must be translated into digital form. To do that, each frame is mounted on a digitizing table. A technician uses a cursor to determine the relative positions of the athlete's limbs, and enters them into a digital display using software that allows for the individual's height, weight, and body build. The result is a series of stick figures that can be compared with sequences taken from a world champion or, for rehabilitation, with the record of the athlete's performance before an injury.

Digitizing film is slow, labor-intensive, and expensive. Video, by contrast, can be shot cheaply, and provides immediate feedback. Researchers in the biomechanics department at the Olympic Training Center are now working on methods of digitizing video that can display an athlete's movements on computer screens almost instantaneously.

The evolution of pressure measurements shows the ability of new technology to move from the general to the particular. Researchers in sports medicine have traditionally used force platforms to measure the pressure exerted on the ground by volleyball players, marksmen, race walkers, and other athletes as they perform. The platform, a square metal plate mounted in the laboratory or on the track, uses piezoelectricity—crystals mounted beneath the plate produce electric charges when they are squeezed. Although the platforms measure overall forces exerted by the feet, they cannot detect the differential forces on various parts of the feet—differences that are critical to participants in the very technical sport of race walking, or to athletes suffering from plantar fasciitis, a weakness in the sole of the foot.

To overcome this problem, biomechanicists at the Olympic Training Center are exploring the electrodynogram. This proprietary device relies on seven sensors glued to different points on the sole of the foot and linked by wires to a data collector hooked around the athlete's waist. At the push of a button on the collector, the system gathers 3,500 data points in five seconds. The data can then be fed into a computer for analysis. The electrodynogram is still undergoing trials and has experienced some problems. But if they are solved, the system will be able to provide more sensitive data for longer periods than is possible using force platforms.

Another device under study recognizes elite athletes' need for instant information. The heart-rate monitor consists of a system taped to the athlete's chest that detects the electrical currents produced by the flow of blood driven by the heart. It transmits the data to a wrist-mounted device that looks like a lap watch, which displays the athlete's heart rate in real time. This enables athletes to check the recovery rate of their pulses during interval training, and to see the effect on their hearts of sudden surges in speed.

Dealing with Injuries

Although sports physicians aim to prevent injuries in their patients, they must frequently practice the art of healing. They increasingly rely on technology to help them in diagnosing ailments and setting up rehabilitation programs.

Imagine the following situations:

☐ On the Monday after a Friday night high-school football game in which a star player injured his knee, an unrelenting coach insists on knowing the exact diagnosis and when the athlete can return to play.

☐ A basketball guard, his parents, and his coach insist that the boy play in the state finals, three days after the semifinal in which he severely sprained his ankle.

☐ A gymnast on a rehabilitation program following surgery to repair a torn meniscus in her knee wants to know when she can return to competition.

Every sports doctor and trainer has faced these situations. Until recently, decisions about when to allow athletes to return to competition had to be based on experience and judgment rather than objective information on an individual patient. The wrong decision could risk further injury to the limb or joint, jeopardize other parts of the body that might have to compensate for the weakness in the injured limb, and put the doctor at risk of a lawsuit.

The key to making the right decisions is fast, appropriate diagnosis. And while sports physicians have long used conventional non-invasive diagnostic technology such as x-rays, an array of new techniques has recently become available that take the guesswork out of diagnosing sports injuries. Tomograms, which show cross-sections of the body, bone scans, CAT scans, and arthroscopic surgery enable us to investigate injured ankles, knees, and other body parts immediately and accurately. And once

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Beating the Clock

MR. America was in Wisconsin, trying on a tuxedo, when Dr. Charles Czeisler called. Two days later Larry Bernstein, the 24-year-old national champion bodybuilder, short class, arrived at Czeisler's laboratory in Boston to spend four days attached to a computer. He was there to help scientists, and eventually athletes, understand how the body's internal clock affects physical performance.

That clock, a pinhead-sized cluster of 10,000 neurons in the brain called the suprachiasmatic nucleus, controls a wide range of daily physiological cycles ranging from body temperature to the release of certain hormones. Czeisler believes that studies of athletes such as Bernstein will eventually uncover a pattern of daily variations in athletic prowess. "I would be dumbfounded if there were no differences," he said.

Those differences may dictate how—or if—athletes should adjust their sleep and training schedules when they cross time zones to compete. Czeisler cautions that it will be difficult to improve an athlete's performance until he collects and analyses more data, but his subject was more optimistic about the immediate benefits of the research. "I compete overseas," Bernstein said before his testing began. By participating in Czeisler's study "I can find out how it affects me."

Bernstein's primary motivation for being tested was to understand his own body better. "The more you know about yourself, the easier it is to tune your body and to control it," he explained. "Certain salt levels and potassium levels will affect your muscle growth or definition. . . . I'll hopefully learn what things I'm getting enough of; maybe I'm not getting enough magnesium or zinc."

Working hard at his play, champion bodybuilder Larry Bernstein does a series of leg extensions at the computerized exercise station in the Neuroendocrinology Laboratory at Boston University. The purpose of the laboratory's study is to understand just how the body's internal clock affects the physical performance of highly trained athletes.

So Mr. America spent nearly as much time questioning the doctors and dietician at Czeisler's lab as they spent interviewing him. "To me," Bernstein added, "being an Olympic athlete is the height of everything." Although bodybuilding is not an Olympic sport, Bernstein felt he became part of the Olympic effort by participating in the study, which is sponsored by the U.S. Olympic Committee.

Batteries of Tests

His ordeal included a 40-hour stretch with no sleep spent sitting in a computerized exercise station—a machine that looks like an armless dentist's chair with a hinged footrest. Every 20 minutes Bernstein spat into a test tube, gave blood for hormone-level testing, and marked an estimate of his alertness on a bar graph. Every hour he drank measured portions of water and a liquid diet to avoid fluctuations in body temperature caused by eating solid food. Every three hours he got a fleeting reprieve from his exercise chair for a short walk to the bathroom; his urine samples were tested for levels of hormones, sodium, and potassium. And every four hours Bernstein did 2,000 foot-pounds worth of leg-extension exercises.

All that activity kept the technicians in Czeisler's Neuroendocrinology Laboratory scurrying but left the experimental subject with lots of free time. "I wrote a couple of letters and watched TV," Bernstein recalled later. "I kept a journal when I was tired of watching television and didn't want to floss my teeth again."

He didn't even have a view. Bernstein's windowless room was kept at a constant level of illumination, because changes in lighting affect the amount of hormones released in the body. The exercise machine to which he was confined was also part of the experiment, because changes in posture can induce local variations in body temperature. Czeisler uses both temperature and hormone release levels to track his subject's circadian cycle—the daily pattern of neuron firing that constitutes the body's clock—and compares it with the subjects' performances recorded by the computer.

Understanding the workings and effects of the circadian cycle can do more than help athletes win gold medals and prevent jet lag, says Czeisler. He has already applied his research to help managers improve workers' productivity by changing their shift-rotation schedules. Now he hopes to develop and refine a diagnostic technique to determine individuals' circadian cycles, which may help doctors identify and treat sleep disorders.

After spending 40 hours awake for testing and then getting some sleep, Bernstein's first priorities were a shower and a shave—once he had removed the motion sensor, electrodes, and rectal thermometer he had worn for a little more than four days. He was no less enthusiastic about participating than he had been at the outset, though he was less sure there would be immediately applicable insights. In fact, Czeisler's group will take several weeks to analyze the data.

Once the doctors and technicians had finished their work and a local television crew had packed its gear, Mr. America reached for a telephone. "Mom?" he said. "I'm out and alive."

—Barry S. Surman □

PHOTO: BARRY SURMAN

The Science of Fair Play

LAST year's Pan American games in Caracas, Venezuela, will go down as a watershed in sport. A new, sensitive testing technique, used for the first time in a major meet, spotted traces of illegal performance-enhancing drugs in 16 athletes competing in five different sports, and scared at least a dozen others into leaving before their events began. Use of the technique signaled the end of the era in which elite athletes could stop taking artificial steroids, stimulants, and other illegal performance enhancers two or three weeks before a major competition, confident that rudimentary tests would show no signs of drug use. The chemical analysis assured athletes that their innate ability is the key to winning medals.

Many athletes think that sports authorities consider all drugs dangerous. In fact, we are only after drugs that enhance performance and make competition unfair—we don't want sport to be simply the best that pharmacology and chemistry can provide. And we don't want athletes to use illegal drugs that can kill them or cause serious medical problems later in life. Finally, we do not want athletes to face the unfair predicament of having to take drugs because they are allegedly taken by athletes in other countries.

The basis of the testing system, which will also be used during the Los Angeles Olympic Games, is a combination of the well-established analytic techniques of gas chromatography and mass spectrometry. The $30,000 gas chromatograph screens a small portion of the urine sample that an athlete provides. As a stream of helium gas sweeps the urine through a long tube, a detector registers a peak on a graph whenever it spots molecules that contain nitrogen or phosphorus—components of almost every banned drug. The time that the peak takes to appear reflects the time that the substance needs to pass through the tube, which in turn gives a strong hint as to the nature of the substance that produced the peak.

When technicians see a peak that seems to correspond to an illegal drug, they run another portion of the urine sample through a mass spectrometer, a $200,000 instrument that fragments molecules into easily recognized pieces. The instrument acts like an unerring fingerprint expert: if fragments in the urine sample fit the pattern of a banned drug programmed into the machine, the test is positive.

Effects of Banned Drugs

Neither mass spectrometry nor gas chromatography is a new technology. So why has the combination only recently replaced the previously used, and relatively insensitive, liquid thin-layer chromatography? The main reason has been the time necessary to program the fingerprints of illegal substances into the testing systems. Only in recent years have chemists completed the task of feeding the profiles of 38,000 known chemicals into the devices. Most of those substances are harmless, and only about 78 generic compositions can be used to enhance performance.

Those fall into three basic categories: central-nervous-system (CNS) stimulators and sympathomimetic drugs, narcotics, and anabolic steroids. The first group constricts blood vessels, increasing blood pressure and heart rate. These drugs can cause cere-

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we have the diagnosis, we can put the injured athlete on rehabilitation machines specifically designed to remove the risk of overworking the recovering joint. The earlier an athlete treats an injury, the better the prognosis for full recovery.

Arthroscopy has become the modern miracle of sports medicine. The arthroscope is a thin tube containing a fiber-optic cable and a magnifying system that enables the surgeon to see clearly inside a joint. Before its appearance, orthopedists would typically splint a damaged knee for ten days to allow the swelling to go down before even attempting any diagnosis. Using arthroscopy, a surgeon looks into the joint as soon as the injury is reported. Even if the problem does not require further surgery, the knee has suffered relatively little damage from the procedure, and the patient can quickly return to normal activity. To correct a simple problem on the spot with relatively little trauma, the surgeon leaves the arthroscope in place and performs the surgery with a small instrument inserted through a tiny hole in another part of the joint. And if the arthroscope shows something serious, the surgeon can easily determine when to open up the joint for corrective surgery.

Joan Benoit provides the classic example of what arthroscopy can do. The holder of the world's record in the women's marathon, Benoit injured her right knee last April during a training run. After rest failed to ease her pain, she underwent arthroscopy. Her surgeon, Stanley James, snipped a bunch of collagen fibers in the front of the knee that seemed to be causing the problem. Just 17 days after the surgery, Benoit won the U.S. Olympic marathon trial.

The Fast Track to Rehabilitation

Once we decide that we need not go further with surgery, we can use machines such as the Orthotron and the Cybex to rehabilitate the athlete as fast as possible. Both are computerized and both can identify specific muscle weaknesses, enabling the athlete to strengthen those weaknesses without damaging the muscles further. Their programming enables the machines to be more flexible than conventional machines. They can measure the force and power that an athlete's muscles generate under various conditions, such as different speeds of movement and ranges of motion.

Each machine gives as much resistance to the limb

A single Cybex test, costing about $150, can give an orthopedist enough information to set up a weight program for any patient.

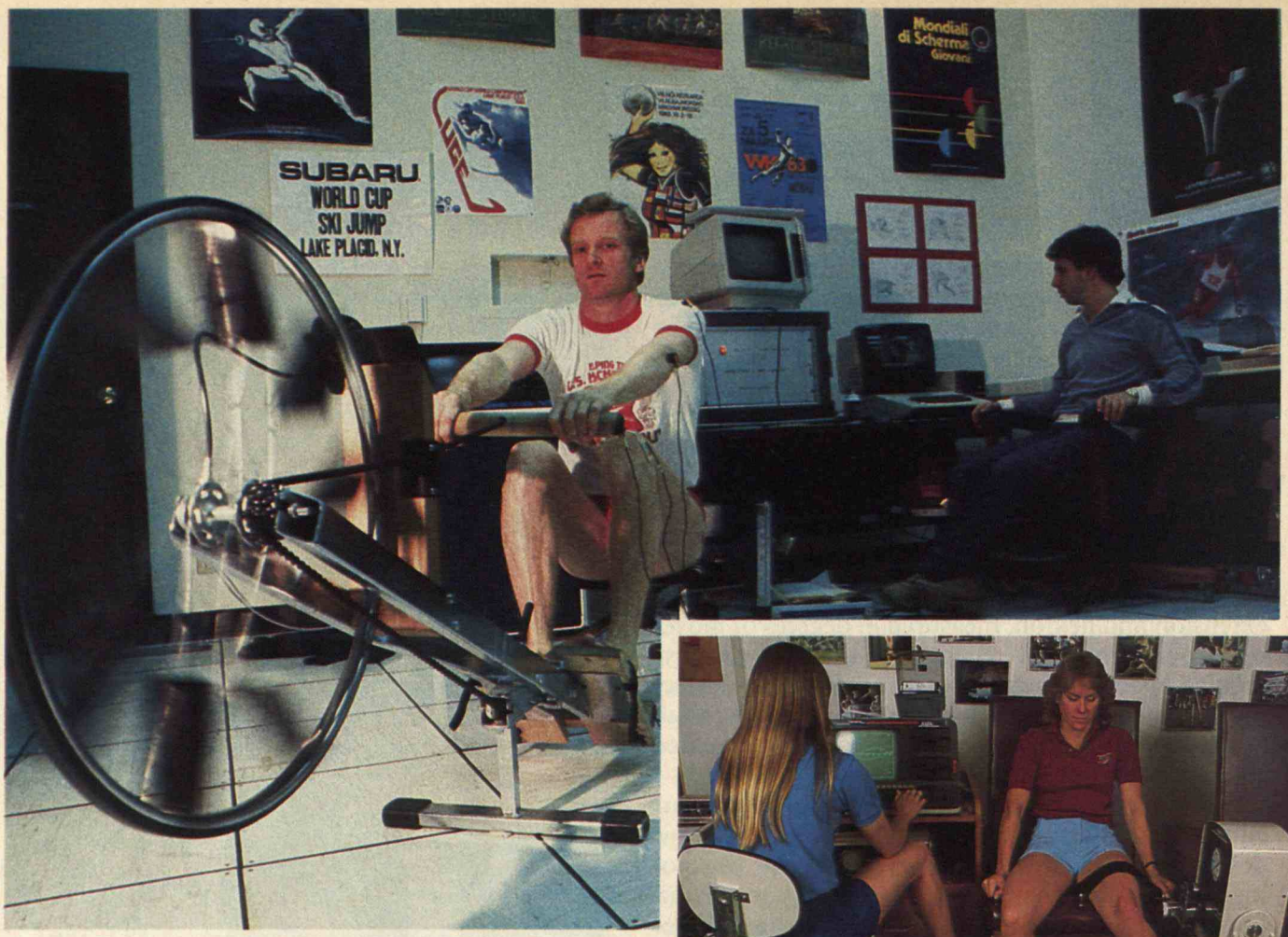
as the athlete gives to the machine. At the Olympic Training Center, we normally use the devices to strengthen athletes' hamstrings and quadriceps. The athlete sits on a chair with the waist, the quadriceps area of the thigh, and the ankle of one leg strapped to the equipment. As the athlete extends the leg against the force of the machine and releases it, the machine measures the peak force exerted and the time taken to achieve that peak. Both factors are vital in determining the athlete's strength and mobility in action on the track, field, or court. The machines can be programmed for different speeds of extension and flexion, measured in degrees of movement per second, in recognition that some sports require faster leg actions than others. The devices can also be programmed to run the athlete through fatigue tests, which measure the force of repeated extensions and contractions.

One other device that we occasionally use for our elite athletes is an electrostimulation unit. This is designed to help the athletes overcome the psychological pain that they suffer when trying to rehabilitate muscles sore from surgery. Recovering athletes frequently experience such severe pain when they undertake rehabilitative exercises that they are afraid to continue, out of concern that they will hurt themselves again. The electrostimulator delivers small currents of electricity to the body through two electrodes placed near the site of the injury. This seems to alleviate some of the pain, probably by scrambling the pain signals on their way to the brain. Hence, the athletes can exercise their injured limbs or muscles as thoroughly as possible, thereby speeding up their recoveries and halting the ever-present loss of vital muscle tone through lack of use. Electrostimulation may even increase patients' muscular strength; one Russian physician has reported a gain of 30 percent in strength. However, that possibility remains a subject for further research.

Recreational athletes can also benefit from the information provided by high-tech machines, even without the daily testing that Olympian hopefuls undergo. A single Cybex test, costing about $150, can give an orthpedist enough information to set up a weight program for any patient.

Despite the new techniques, rehabilitation doesn't always work perfectly. Either the treatment fails to provide a 100 percent cure or the patient loses some desire for the sport during recovery. At that point sports medicine becomes more than ever a pursuit

Hooked up to a monitor that analyzes the gases he breathes in and out, a runner piles up the miles on a treadmill. The purpose of the device is to measure athletes' efficiency in using oxygen. But attempts to use such knowledge to improve performance have been disappointing.



Surrounded by the products of modern electronics, an athlete undergoes strength testing (above) in the biomechanics laboratory at the U.S. Olympic Training Center. Trainers and physicians in the center's department of sports medicine use a variety of equipment to rehabilitate injured athletes. The Cybex (right) tests recovering muscles' ability to exert force at different speeds.

carried out by people rather than machines.

The crux of the rehabilitative process comes when we take the athlete back to the arena to see what he or she can do. The patient runs drills and does all the exercises essential for the individual sport to see if he or she can perform without disability. Sports physicians can normally tell if the athlete has regained all the old ability simply by watching those performances.

We look for small signs. One promising college basketball player, for example, spent a long period rehabilitating after surgery before returning to the court. Offensively he was still a superior player, fully restored to normal. But because of his injury, he had lost some of his defensive skill. He couldn't return to complete capability as a basketball player.

All athletes who are injured seriously enough to require surgery must realize the possibility of such a fate. They may have to settle for only a percentage improvement in an injured body part rather than complete recovery. Sometimes that's not enough for world-class athletes, who must realize that they have not achieved their original expectations—and will not be able to. That knowledge can be just as devastating for a recreational athlete who realizes that he or she really won't be able to run a three-and-a-half hour marathon or win the club tennis title.

Yet there is one consolation: there is always another sport. Guided by counseling from a sports physician, the injured basketball player took up tennis and became a very good club player. A football linebacker with a knee that has not recovered 100 percent might consider becoming a guard. And the runner whose knees can no longer stand up to a marathon can always take up biking or hiking to maintain fitness. Technology can do a great deal for athletes at all levels of ability, but the athlete has the final say in the breadth of his or her horizons.

ROBERT O. VOY, M.D., is chief medical officer at the U.S. Olympic Training Center in Colorado Springs.

The Science of Fair Play

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bral hemorrhage and cardiac arrest as a result of overstimulation. Narcotics produce about 60 minutes of euphoria followed by lethargy, and carry many of the same hazards created by CNS stimulants. Anabolic steroids, used most commonly by weight lifters and field athletes in strength events such as the hammer throw and shot put, probably increase muscle mass, although we are not certain about their effects on strength. But these drugs have catastrophic side-effects, such as excessive masculinization in the short term and long-term time-bombs that include liver cancer, atherosclerosis, and heart disease.

Athletes don't always take banned drugs for improper reasons. In 1972, American swimmer Rick DeMont was stripped of the gold medal he had won in the 400-meter freestyle event because he had taken a medicine prescribed for his asthma that contained ephedrine, a banned stimulant. In fact, the greatest concern of team physicians is the ready availability of seemingly innocent preparations such as cold and sinus preparations that contain small amounts of these stimulants. However, plenty of medications that aren't on the list can be used to give athletes relief from asthma, bumps and bruises, pain, and other common medical problems.

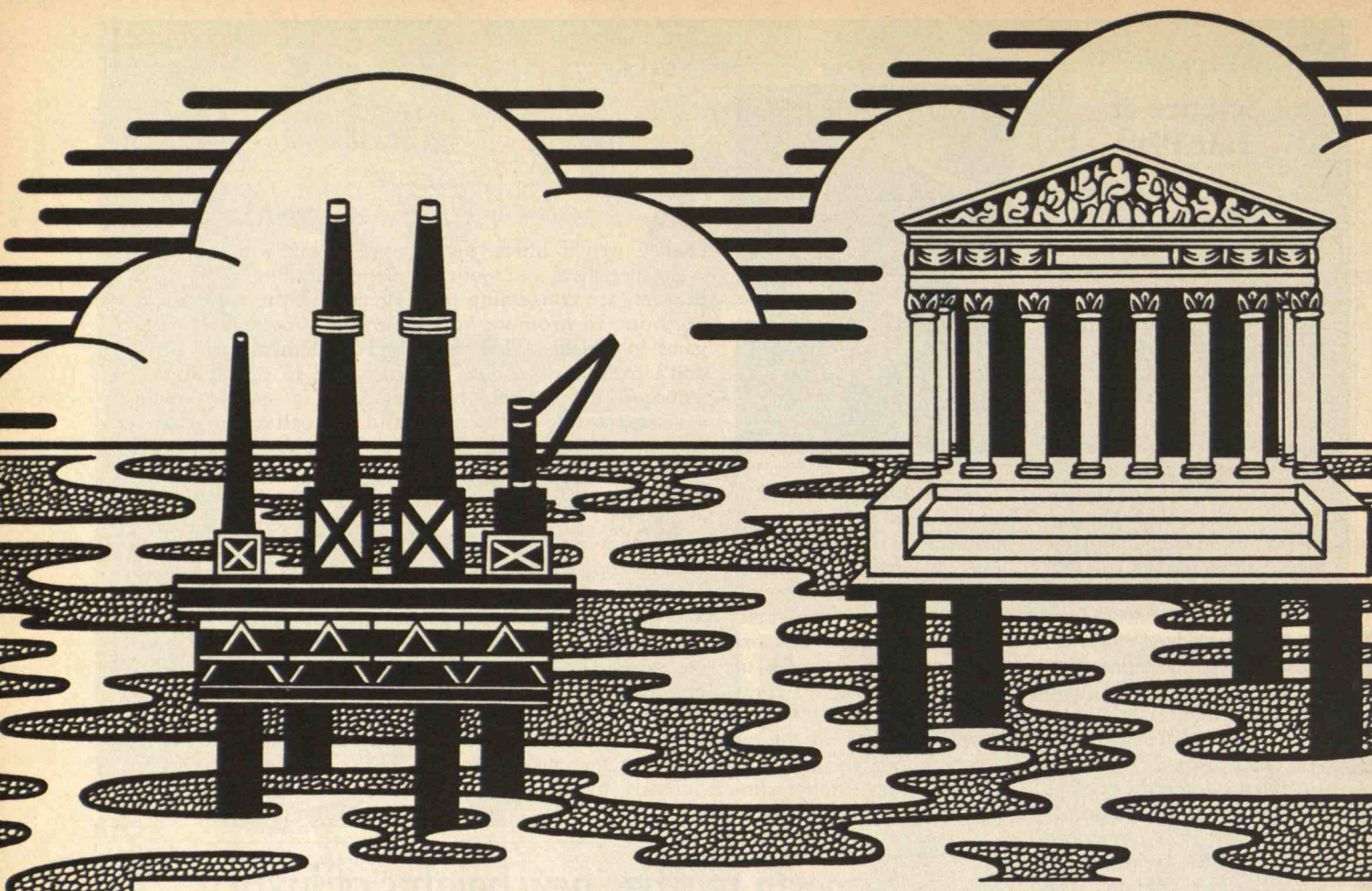
Indetectable Enhancers

Some athletes will always try to bend the rules, and sports physicians cannot keep up to date on the use of every new performance enhancer. One difficulty is that we can't draw blood from athletes because of individual rights and religious preferences. We can detect substances in the blood only indirectly through urine samples.

One substance of concern, human growth hormone, is indetectable at present. Naturally secreted by the pituitary gland, it can be obtained in artificially concentrated form from cadavers. Doctors use most of the supplies of growth hormone to treat cases of dwarfism, which is caused by failure of the pituitary gland in children. However, some athletes, including weight lifters, field-event specialists, and football players, are consuming the hormone to promote huge gains in weight. What they don't realize—or choose to ignore—is that the substance can cause a wide spectrum of ailments, including diabetes, enlargment of the liver, and excessive growth of bones and joints.

Another dubious procedure is blood packing. A pint of an athlete's blood is frozen and then transfused back to the athlete shortly before a big event. The idea is to improve the athlete's uptake of oxygen by adding red blood cells. (The athlete could accomplish that task more efficiently by inhaling pure oxygen, but you won't win many marathons with an oxygen tank on your back.) However, the athlete's heart and circulatory system are accustomed to operating with blood of a specific volume and viscosity; the change could cause pulmonary edema or heart failure. And scientists are still not completely sure what happens to the blood while in storage.

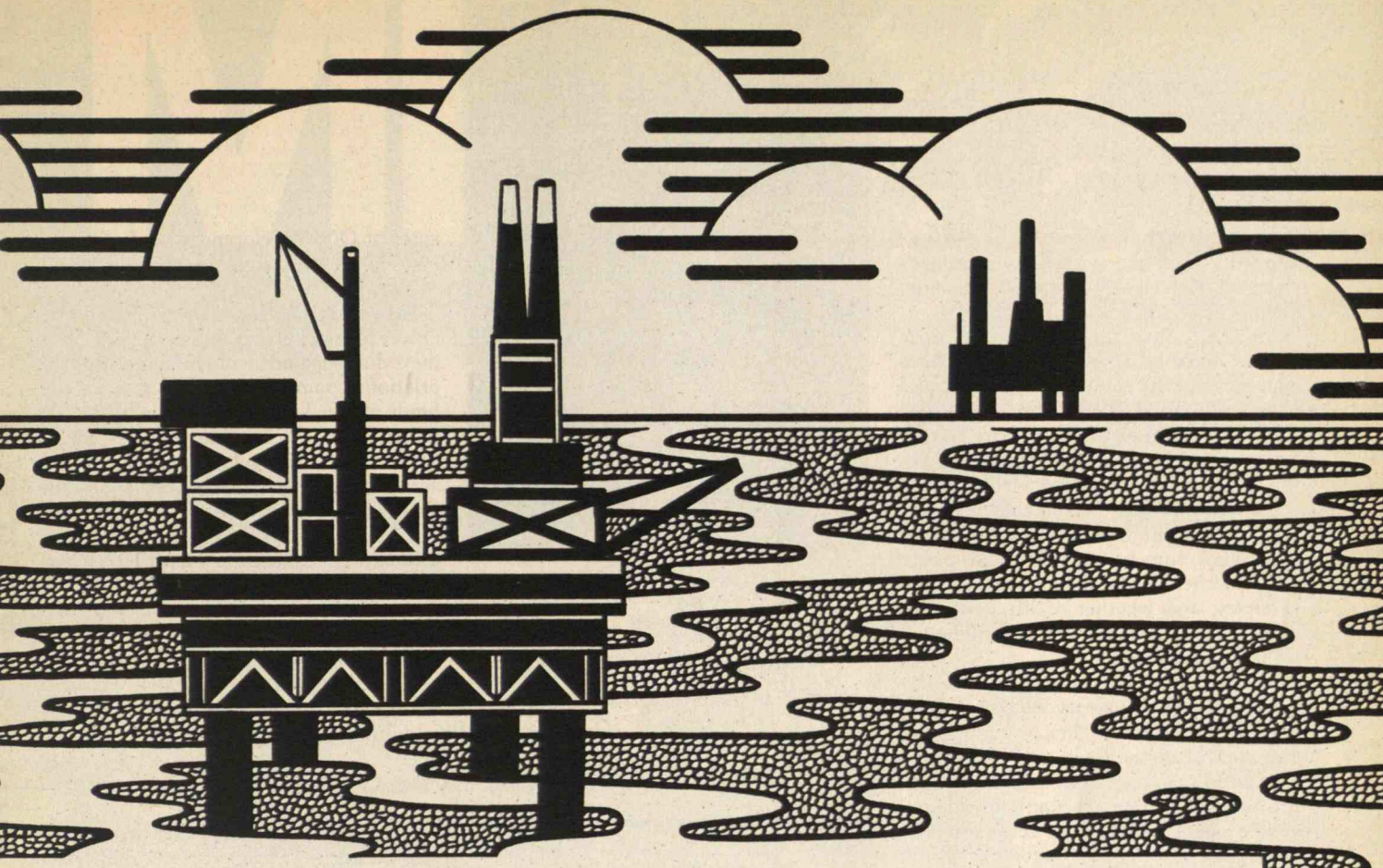
Urine tests are being developed for human growth hormone and frozen red cells reintroduced into the body. After closing in on the performance enhancers last year, analytical scientists are unlikely to let them get far ahead in the future.—*Robert O. Voy* □



Mixing Offshore Oil and Politics

BY PATRICK LAWRENCE

Opposition to offshore oil drilling, led by worried legislators from coastal states, is slowing the U.S. government's plans for exploration.



THE Seaweed Rebellion, the opposition of coastal states to oil drilling off their shores, is dealing a crippling blow to the U.S. government's schedule for offshore exploration. Like the Sagebrush Rebellion by Western states that bushwacked many federal programs in recent years, the revolt is rooted in the issue of states' rights. The uprising has added an element of political risk that U.S. oil companies never thought they would confront at home.

For decades, the risk of overseas exploration prompted oil companies to balance foreign and domestic investments. If a company concentrated too heavily overseas, it could be shattered by sudden expropriations or tax increases. U.S. waters were considered absolutely safe politically, although the potential for major discoveries was smaller. But companies are

ILLUSTRATION: LUCY RASTETTER

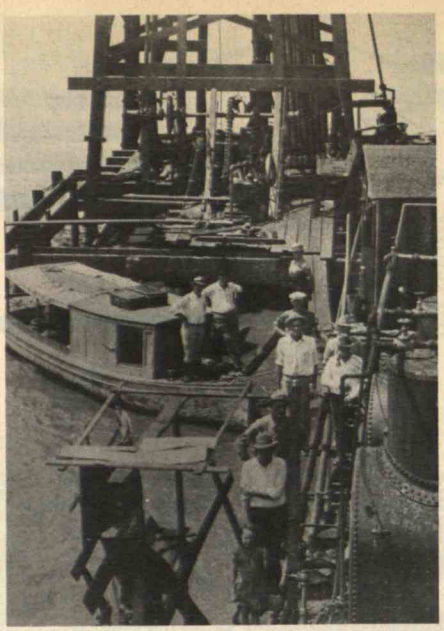
now seeing their exploratory wings clipped as their access to the government's share of the oil-rich Outer Continental Shelf (OCS) is decreased.

Indeed, controversies over offshore drilling have billowed into a maelstrom engulfing the Reagan administration and Congress. While states own the seabed within three miles of their shore, everything beyond that out to 200 miles belongs to Uncle Sam. But legislators from coastal states are spurring heated debate about how much input to permit the states in the federal government's offshore leasing process, whether to allot them a share of OCS revenues, and whether to lift, retain, or expand moratoria preventing drilling off several coasts.

The Reagan administration for its part is attempting to juggle its competing goals of promoting states' rights, preserving federal control of the OCS, and developing the nation's energy resources. The government is fighting to protect not only its sovereign rights but also its revenues. The Interior Department estimates that oil and gas royalties and bonuses—the premiums companies pay to lease OSC tracts—will total $7.4 billion in fiscal 1985. Once again, they will be the treasury's largest source of income aside from income taxes.

The Interior Department has been selling offshore leases since 1954, mostly in the Gulf of Mexico off Texas and Louisiana and many in the Pacific off California. Few people complained until the 1969 oil spill off Santa Barbara, Calif., and opposition continued with the growth of the environmental movement. Former Interior Secretary James Watt fanned the sparks during the first few years of the Reagan administration with an aggressive OCS leasing program. Until then, oil companies had leased only 28 million acres—about 2.5 percent of the OCS. With an eye on the nation's dependence on imported oil, Watt adopted the goal of assessing the resources of the entire OCS with the drill bit. He planned to offer the oil industry as much exploration acreage as it could tackle.

Watt also changed the leasing process. Previously, the Interior Department outlined regions within which oil companies nominated tracts for closed-bid sales. "The past procedure of the government limiting areas for exploratory activity has not worked," Watt declared. So he instituted "area-wide" leasing, which threw open vast OCS regions for nomination and eventual sale. In fact, his first five-year leasing plan included more acreage than had been leased in the program's entire history.



From humble origins, the Gulf of Mexico has become the world's busiest offshore oil-producing region.

Stiff-arming complaints about lease sales on the OCS, Watt was able to hold sales without interruption off Texas and Louisiana. But lawsuits delayed or crippled proposed sales off California and Alaska and all along the Atlantic Coast. The objections varied, but generally states and environmentalists feared that drilling activity and potential oil spills might damage fishing grounds and marine life. They also worried about the hazards of boom-or-bust oil developments and the "visual pollution" of production platforms on the horizon. According to Sarah Chasis, an attorney for the Natural Resources Defense Council, "The incredible pace and magnitude of leasing proposed threatens the ability of federal, state, and local government to adequately assess the environmental impact of leasing and plan for the impacts of oil production."

Some members of Congress sympathized. For example, Representative Leon Panetta (D-Calif.) notes that sport fishing in his state is a $75 million a year industry, commercial fishing $882 million, and tourism (largely coast related) $15 billion. "Small-business owners, fishermen, local government officials, and private citizens along the coast are concerned that the costs of OCS development off California may not be outweighed by the benefits," he says.

However, the legislators lacked the power to enact broad antileasing bills. But they did persuade congressional appropriations committees to deny Interior the funds it needed to plan sales off their coasts. The first funding moratorium in fiscal 1983 effectively placed 1 million acres off limits to oil and gas leasing. Congress increased that total to 52 million acres in 1984 and may continue the ban for another year. But in June a House appropriations committee rejected a recommended moratorium covering lease sale, set for next August, of tracts in the Bristol Bay region of the North Aleutian basin off southwestern Alaska. The legislators overrode worries about the area's salmon fishery.

From Confrontation to Compromise

Secretary Watt resigned under fire last fall and President Reagan replaced him with William Clark, former national security advisor and California supreme court justice. "Judge" Clark has been as conciliatory as Watt was confrontational; he has offered the olive branch to nearly anyone within reach. He replaced Watt's top aides and revised many of his OCS leasing policies just shy of the point of reversal. "The purpose of the policy changes," says Clark, "is to increase state and public participation, to identify and resolve issues earlier, and to better focus on areas where the oil industry truly seeks to search and produce."

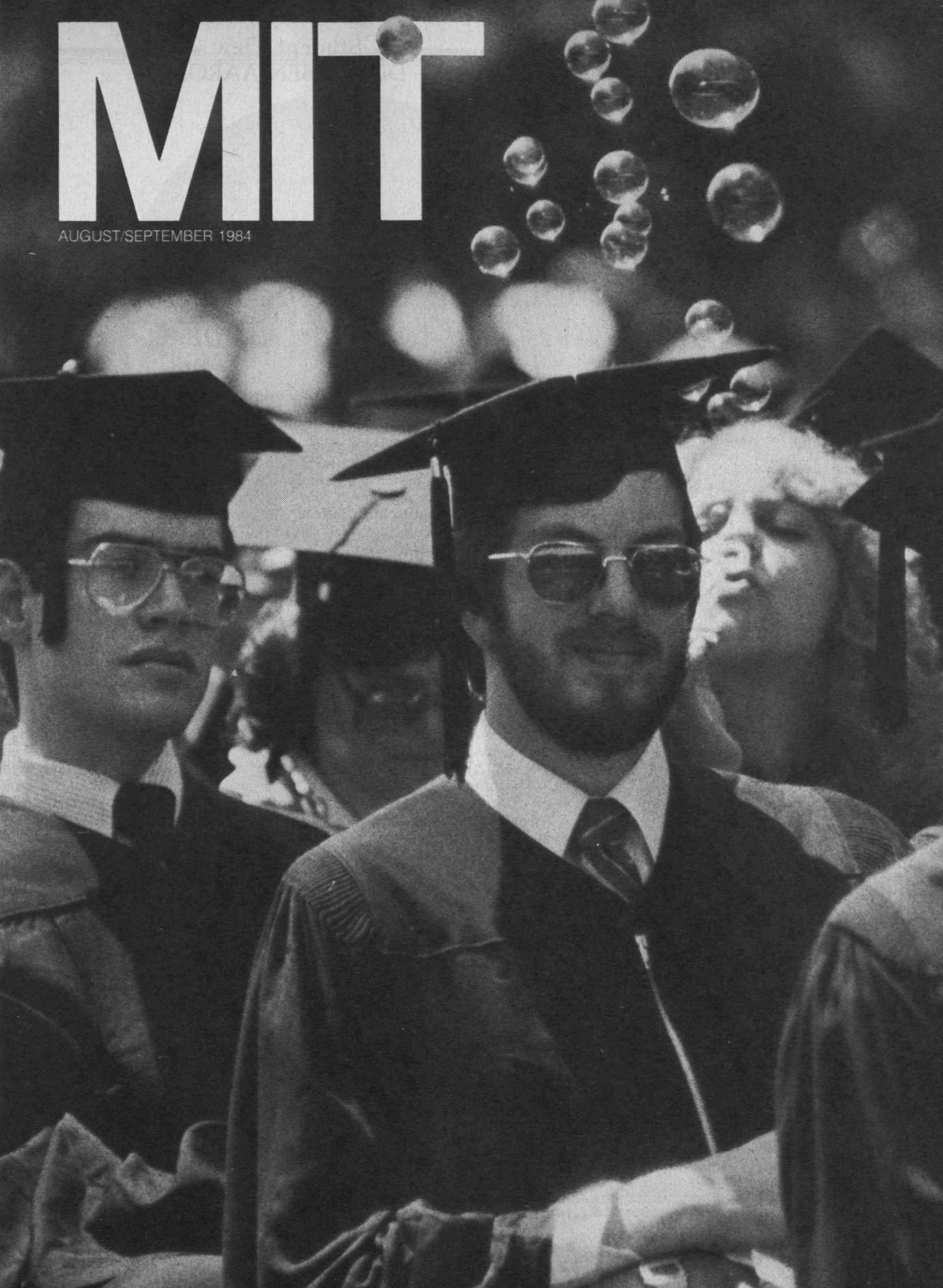
The leasing process takes two years. The Interior Department identifies an area, calls for suggestions, prepares a draft environmental-impact statement, and surveys the hydrocarbon potential. After the EPA approves the final environmental-impact statement, the department announces the sale and solicits comments from coastal-state governors. During a sale, Interior can accept or reject the high bids for each tract. Oil companies must then submit extensive safety and environmental-protection plans before drilling can finally begin.

By involving the states and the public more closely and resolving their objections earlier, Secretary Clark hopes to avoid courtroom confrontations on the eve of sales. For example, he proposes "to make more key decisions in the fourth month of

PHOTO: WORLD OIL

MIT

AUGUST/SEPTEMBER 1984



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In This Issue

Honors From CASE

The Council for the Advancement of Support of Education (CASE) named *Technology Review* 1983-84 winner of the Sibley Award, which annually designates the "magazine of the year" among the publications from almost 2,500 independent schools, colleges, and universities across North America.

This is the third Sibley for *Technology Review;* we were similarly honored in 1944 and 1979.

Two other significant awards came to M.I.T. at the CASE annual meeting:

☐ An "exceptional achievement" award in the category of alumni programs and projects for the M.I.T. Enterprise Forum, a volunteer effort by alumni to provide advice and encouragement to innovators and high-technology entrepreneurs in Boston, New York, Washington, San Francisco, and Los Angeles.

☐ A place among eight finalists for CASE's "professor of the year" to Robert W. Mann, '50, Whitaker Professor of Biomedical Engineering, who has just concluded a term as president of the M.I.T. Alumni Association. The final selection will be announced in the fall.

DIANA BEN-AARON

Studying Naval Architecture: One Way to Learn That You Really Wanted to Be a Doctor

I used to have a great lead for a column. It went like this: "When Roxanne E. Busse, '84, walks out of Killian Court after commencement, she will be marching to a different drummer." Now I'll never be able to use it. Roxanne is marching to such a different drummer she did not even go to commencement. She went to India instead and the next day, dressed in a sari, she was a guest at an Indian wedding.

Roxanne graduated a year early—she used to be '85—to take a trip around the world. Thor Heyderdahl, Herman Melville, and *Fodor's South Seas* have been her leisure reading for two years, as she planned every detail of her great escape. She did not enjoy her stay in Cambridge and was unable to understand the perverse attachment to M.I.T. that leads so many former students to hang around the campus in the belief they could not be happy anywhere else. "Taking a term off from M.I.T.," she once said, "would be like pushing the snooze button on my alarm clock."

"I have it all worked out," Roxanne used to say, whipping out a pocket-sized atlas. "I want to go to this group of islands." She pointed to a dot in the middle of the South Pacific. "The boats only run once a month, and if the boat I want leaves during finals week, I'll petition to take my finals early." At the end of last term, she was phoning her travel agent between classes, bringing him up to date on the changes in her itinerary.

Roxanne's five-month, ten-country odyssey will cost less than a fourth year at M.I.T. When she comes back, she will work for an aerospace company, developing epoxy compounds for use in helicopter blades. But for now, she is doing exactly what she wants to do.

Trading Dockside for Bedside

Mary Ann graduated, but she's planning to go back to school soon. After four years of naval architecture she found that only the Navy is building ships any more, and she doesn't want to work for the Navy.

More importantly, some part-time counseling work she did while writing her thesis made her realize that she really wants to be a doctor. She's getting married in June; when she returns from her honeymoon she'll work half-time, take some post-graduate pre-med courses, and study for her MCATs. She doesn't consider the past four years wasted; in fact, she considers herself lucky that she discovered so soon what she really wants to do.

All Night Bakery to Fortune 500

Last year, when Larry was a junior, someone told me he was planning to get degrees in literature and chemical engineering and then go back to Hawaii to open an all-night donut bakery. I asked him about it. "That's right. I even tried to get a summer job in a bakery—you know, learn the business from the ground up—but no one would hire me," he said. "They thought I was overqualified or something."

The next summer, Larry went into the silkscreening business. Now he's changed his direction yet again and he'll be working for a Fortune 500 company as an engineer. At the moment, anyway, he is happy in the certainty that he'll be using his degree to do what he really wants to do.

Diana ben-Aaron, '85, is majoring in humanities and materials science and she is the newly-elected editor-in-chief of *The Tech*. This particular column was first addressed to fellow students and new graduates from the pages of *The Tech*'s Commencement issue.

ILLUSTRATION: ELIZABETH SLOTE

First Zork, Then a Life Plan

Jeannine finally graduated. She was in college thirteen years: four years for the first bachelor's, two years for the second bachelor's, two years for the master's, and five years for the Ph.D. Her first bachelor's is in mathematics and all the rest of her degrees are in electrical engineering.

"Let me see," Jeannine said to one of her annual IAP classes in paperfolding polyhedra. (All but one of her techniques for faceting paper without using scissors, tape, or concealed pockets are original; every such paper solid you see hanging from an Institute ceiling can trace its origin back to Jeannine.) "How did I become an engineer?

"Well, I worked in a bike shop to put myself through school," said Jeannine. "After I got my bachelor's I couldn't find a job and I ended up still working in the bike shop. I looked around and here I was with a B.S. in math and I was a lousy *salesgirl*!

"Then I looked at Tom," Jeannine continued. "Tom had a master's in math and Tom was a repairman. That's not much, but it beats being a salesgirl; it's one step higher on the social scale.

"And then I looked at Harvey," Jeannine said. "Harvey had a Ph.D. in math and he was a manager."

"Well," said Jeannine, "I looked at the bike shop and decided that I didn't want to be there for the rest of my life."

Jeannine has applied to NASA as an astronaut and several companies want her to work for them. Yet she often says she doesn't want to leave academia; after twenty-five years as a student, she feels at home in schools. If she chooses to join a college faculty, she will be one of only a handful of electrical engineering Ph.Ds who do. Literally, a handful—only eight of 127 E.E. Ph.Ds in America chose to go into teaching last year. This is why Course 6 can't keep up with the enrollment; professors left over from the years before a doctorate was a faculty prerequisite will retire faster than the department can hire replacements.

"What are you going to do?" I asked.

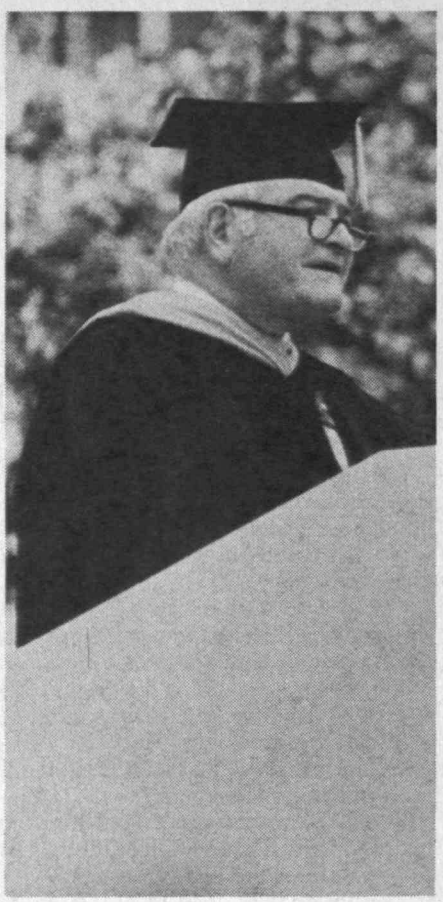
"After I graduate," said Jeannine firmly, "I'm going to sit down at a computer and play Zork."

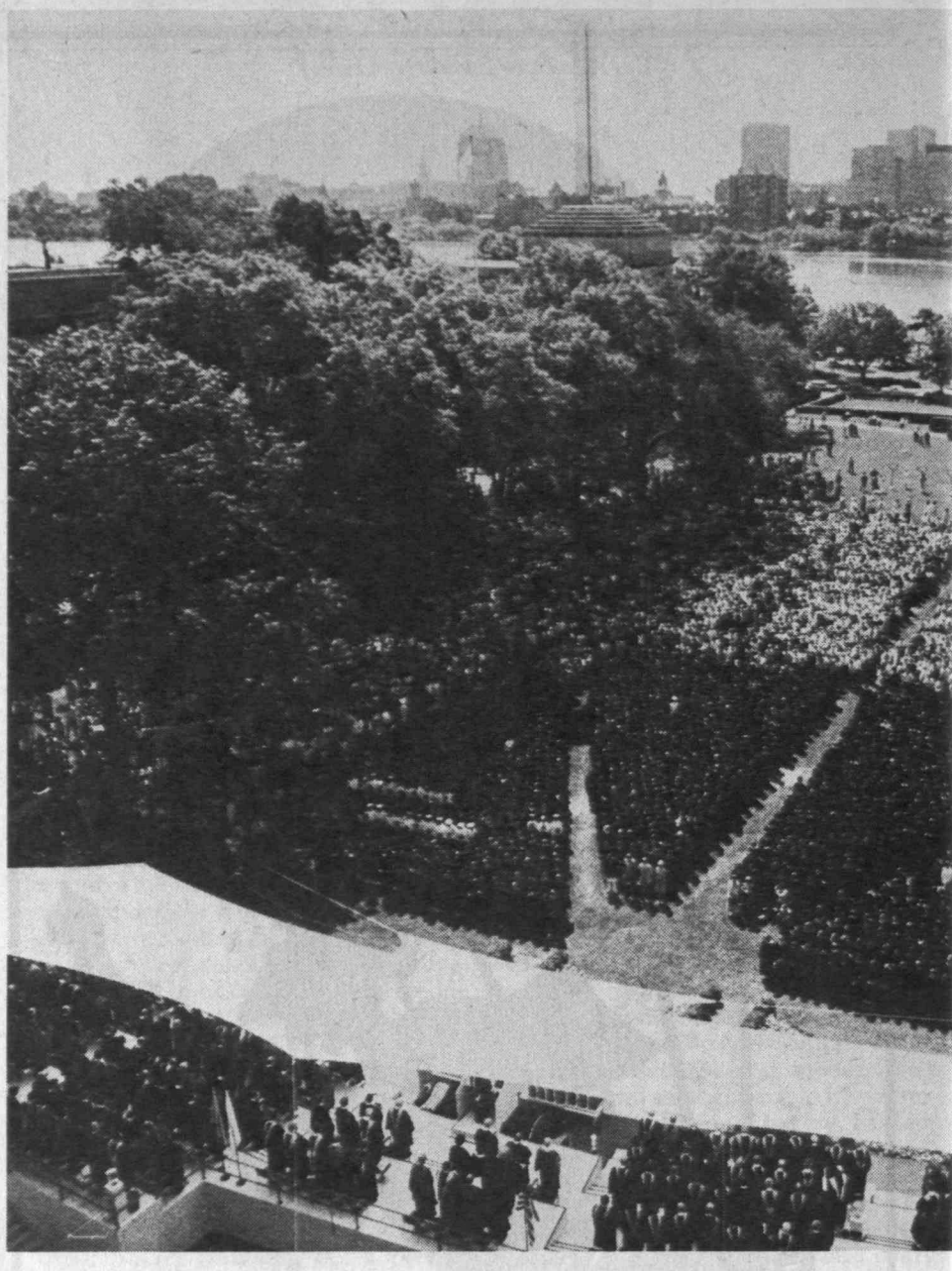
"For the rest of your life?"

"No," said Jeannine. "Until I win. And then I'm going to decide what I want do with the rest of my life."

The Meaning of It All

If there is a theme behind this string of vignettes, let it be this: Don't settle for anything less than the future you really want. You may have to defer your dreams for a few years or until your vacations, depending on what you want, but keep your particular vision of paradise in the back of your head. And remember, it's never too late to change your mind. □





Gray Charges Graduates to Embrace Diversity

Following is the text of the charge to the graduates, delivered by Paul E. Gray, '54, to members of the Class of 1984 at Commencement Exercises on June 4, 1984.

I carry a special feeling for this year's graduating seniors. Four years ago we gathered together in this Court as green freshmen. You were first-year students just beginning your studies here, and I was a freshly picked president. Now you, our newest graduates, go on to new chapters in your careers—while I, in contrast, will stay right here and try again until I get it right!

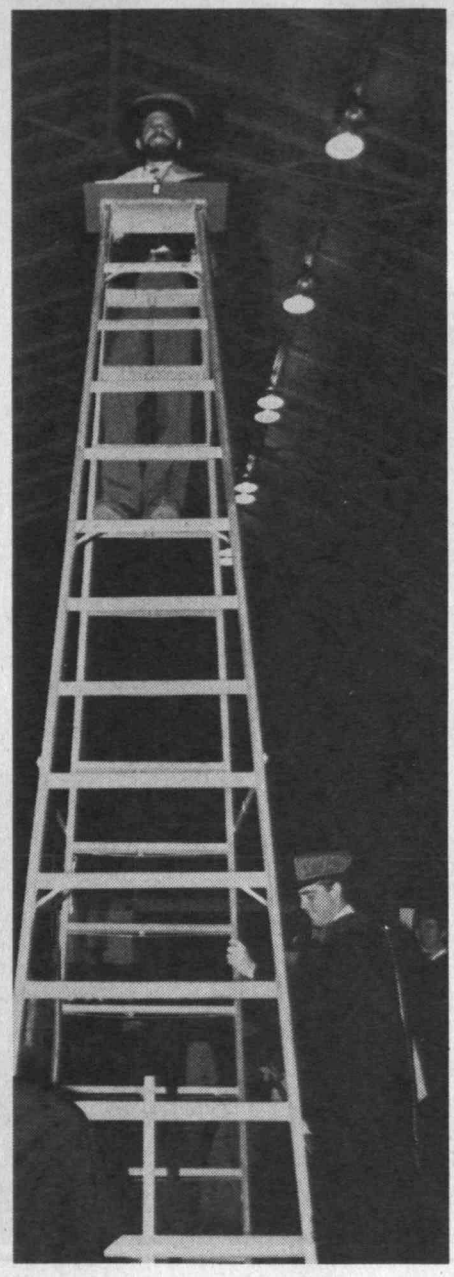
When I first spoke to you at the time of the freshman picnic, I allowed that we all had much to learn in the next four years. Surely we have. And one of the things I hope we have all learned has to do with developing a sense of perspective about ourselves, our beliefs and ideas; a sense of our place in the community and the world; and an ability to judge and appreciate the *significance* of things.

I would like to reflect just a bit here about the meaning of significance and how it relates to our education. When you entered here, I imagine that most of you thought that the word "significant" meant something of importance, of value, something impressive, meaningful—even grand. Significance was a quality that could refer to an object, an idea, a person. Some of you then, and all of you now, know that significance has also quantitative meanings, as in the significance of data, in the recognition of significant figures, and in statistical significance. Those quantitative meanings have become part of your vocabulary, and indeed, have become powerful tools for analyzing and judging many of the questions you face.

But I would hope that your education here has supported and enhanced your understanding of significance in its *many* dimensions. For the concept of quantitative significance is also a dangerously seductive notion, and one which deserves a certain scutiny.

I was prompted to make these remarks by a conversation I had a few weeks ago with some students on a question that had raised strongly divergent opinions and feelings in this community. In the course of this particular discussion, one participant—referring to some others who held differing views—said, "But those people aren't significant!" Now that comment was meant to refer to the *number* of people holding that view, but it carried some other unintended and very powerful connotations as well.

It betrayed a mindset that can—and in this case did—drive out appreciation of individuals and of individual differences. And it illustrated for me the subtly seductive quality of quantitative



After a week of rain that ranged all the way from drizzle to deluge, it was surely with relief as well as pleasure that Paul Gray, '54, (far left) stood in the brilliant sunshine to address the 1,673 students and some 6,000 members of their families and friends gathered to celebrate M.I.T.'s 118th Commencement. In a ceremony that had been planned minute by minute for weeks, a total of 973 baccalaureate degrees and 877 advanced degrees was awarded. (Photographs by Frank Revi '86, and Calvin Campbell.)

"There's no place to go from here but down," quipped Professor John Kassakian, '65, as he gave the robed graduates their marching orders in the du Pont Center Gymnasium. It was Kassakian's last year as marshal of the graduates, he said—an assignment in which he has taken delight and pride.

Above: The exuberance of this pair from "that legendary band of survivors known as M.I.T. alumni" says it all. (Photograph by John Mattill.)

significance, a concept that simplifies the world—a world where natural phenomena, to say nothing of human values and the forces which influence human behavior, are endlessly complex.

It is not easy to live in a society which, on principle, seeks to accommodate a variety and divergence of viewpoints while still maintaining a sense of common purpose or community. But that is the nature of M.I.T., and that is the nature of the societies which most of you will enter when you leave here. We need to appreciate these differences, to learn from them and grow from them. For without challenges to our own way of thinking and seeing, we soon grow dull and insular.

Alfred North Whitehead, writing on *Science and the Modern World*, put it very well, I think, when he said, "A diversification among human communities is essential for the provision of the incentive and material for the Odyssey of the human spirit. Other nations of different habits are not enemies: they are godsends. Men require of their neighbours something sufficiently akin to be understood, something sufficiently different to provoke attention, and something great enough to command admiration."

It is through exposure to differences, to new things and new ideas and new feelings, that human beings grow. The history of human society is testimony to that. But if the only ideas or people, considered to be of value in this world are those which pass some threshold, our potential is severely limited. Too great attention to the quantitative aspects of significance can cause us to:

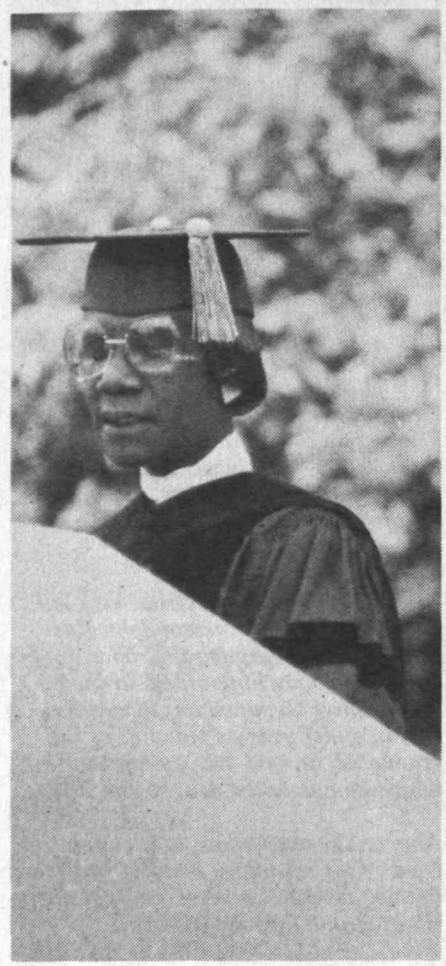
☐ Dismiss important and valid viewpoints held by only a few.

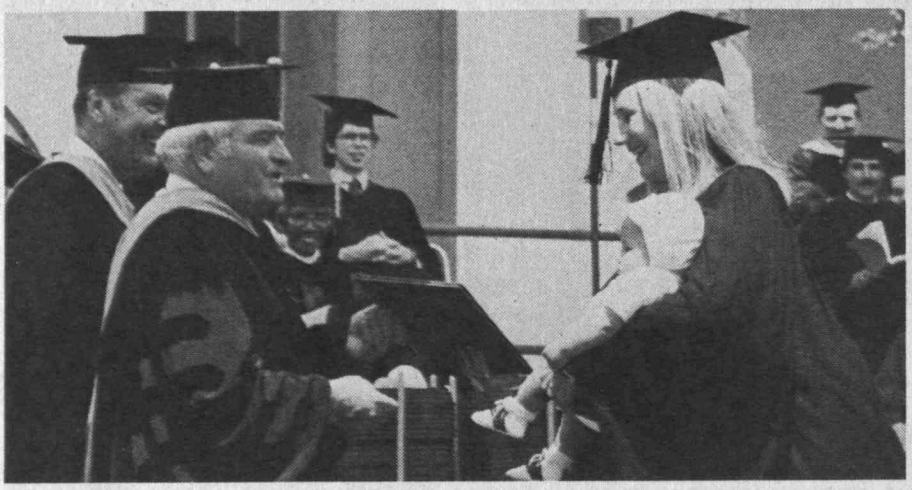
☐ Overlook or dismiss an exotic, offbeat, divergent and—just perhaps—*important* idea rather than see it, with its new light, as a novel way to understand some facet of the world.

☐ Exclude other people rather than identify with them—seeking control rather than communion.

I hope that your years at M.I.T. have expanded your delight in the richness of human variability, your openness to a multitude of ideas and values, and your understanding that, in the end, it is *human* significance—the dignity, worth, and contributions of individual men and women—that matters most.

And now, as you leave these halls, I charge you, the leaders of the next century, to greet the differences you encounter among people, among cultures, among nations, as the godsends that they are. ☐





Distillations of a 24-Year Battle for Equality

"Let's talk about you as spouses, parents and members of the global community."

Following is the text of the address by Shirley Chisholm, seven-time Congresswoman and now a professor at Mount Holyoke, at the 118th Graduation Exercises on June 4, 1984.

I would like today to speak about the kinds of things about which I am deeply concerned and I hope you will be concerned, also. I talk about those things because I believe they are important to everyone, and I talk about them because they have been the focus of my life's work.

Let me say, for example, why I have fought so hard for 24 years for equality of opportunity for people of all races and all backgrounds: for the black women of Brooklyn and of Roxbury, for the white women of San Francisco and Cambridge as well as for white men and black men and Spanish-speaking men from every corner of this country.

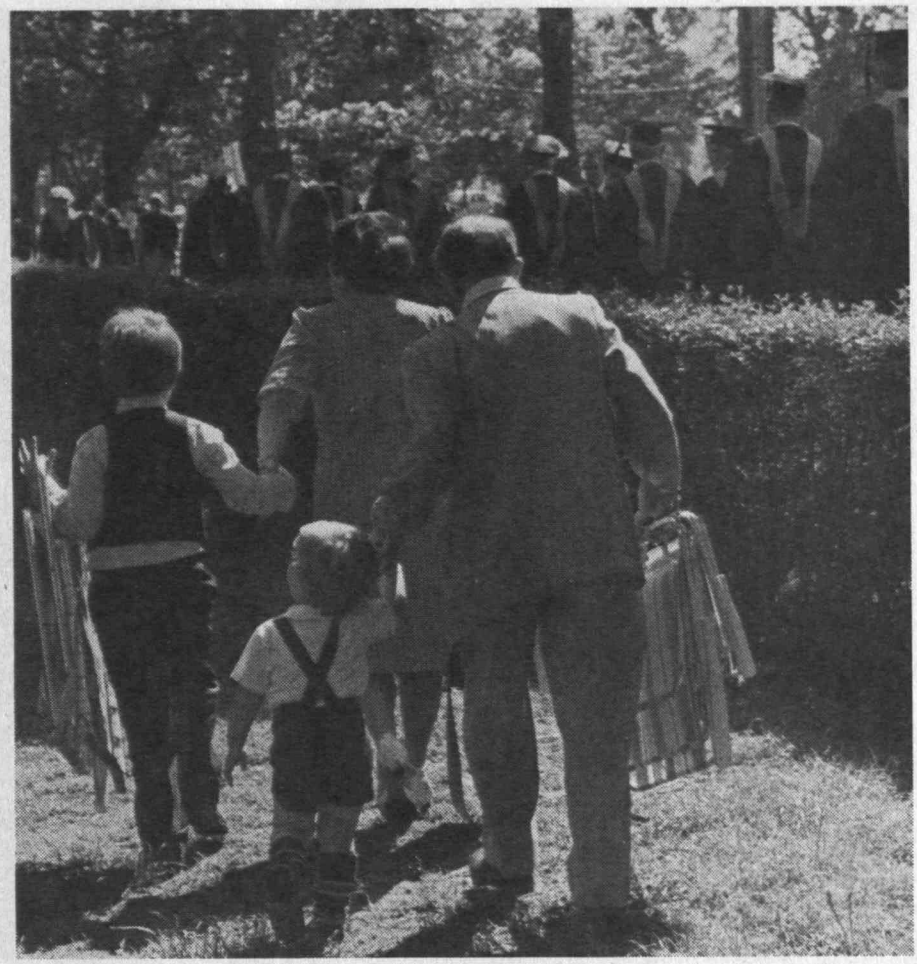
And I want to say, too, why I have fought so hard for effective, generous and compassionate action by government that has been necessary and continues to be necessary to ensure that equality of opportunity—not rhetorically but in actuality—truly exists in America.

I know I do not have to give anyone here a history lesson about inequality and discrimination in our nation. Everyone knows that it has not been possible for every American to have equal access to a decent job, a nice place to live, a voice in our political system, or a chance to attend a fine educational institution like this one.

There has been inequality; there still is inequality, and we need generous public support for proven programs on affirmative action, housing, education,

It has been horrible and wonderful, frustrating and rewarding, all in all, an unforgettable experience.

FROM TECHNIQUE '84



Shirley Chisholm (far left) was at the right place to talk about caring parents. They were much in evidence: a new father with newer Ph.D.; outgoing alumni president and Chief Commencement Marshal Robert W. Mann, '50, with his family's newest Ph.D.-holder, daughter Catherine; Barbara Jane Stokel-Protzko receiving her S.M. with six-month-old Jamie in her arms; 86-year-old Nellie Freer, who drove for three days from Minnesota to see grandson Fred Nelson graduate; and the grandparents with their small charges hurrying to their places. (Photographs by Frank Revi '86.)

employment, legal services, and whatever other problem areas that still continue to raise their ugly heads.

Recently I heard a story about three people who died and appeared at the gates of heaven at the same time. The three—a white man, a white woman, and a black man—were greeted very warmly by Saint Peter. He said that each of them had earned eternity in paradise but, as a formality, he had to ask them each just one question.

To the white man, Saint Peter asked, "How many United States Senators are there?" The man answered, "One hundred," and he was waved through the pearly gates. Saint Peter asked the white woman, "How many members are there in the U.S. House of Representatives?" She thought a minute and then she answered, "Four hundred and thirty-five." She, too, was admitted. Saint Peter then turned to the black man and he said, "Name them."

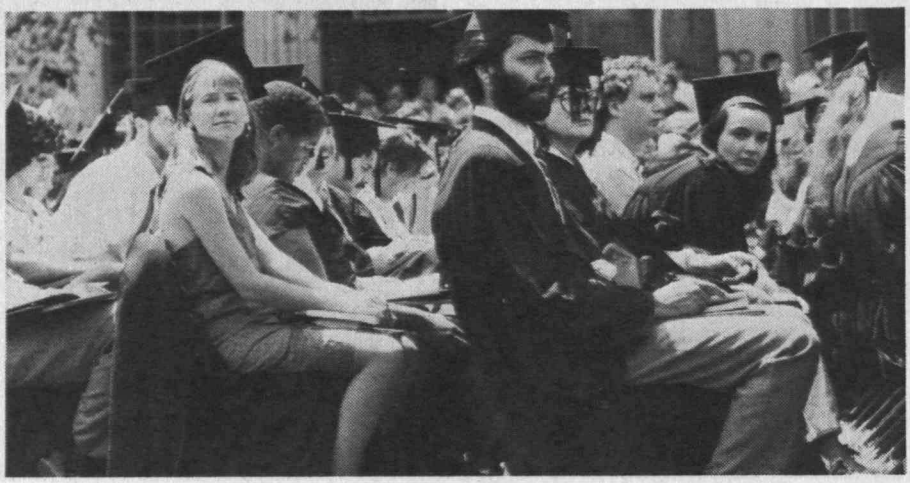
And that is a true story. Only it happened here on earth: here in our country countless times when black people tried to vote or tried to apply for good jobs or tried to enter good schools. But thanks to civil rights laws—which have worked, by the way; thanks to antipoverty programs—which have worked, thanks to active and involved citizens of all colors and sexes and ages, and thanks to a reawakened spirit of conscience in America, the most blatant cases of discrimination are disappearing.

Humanitarian Responsibilities

But more needs to be done. And I know you may be wondering how you can make a difference. You have been fortunate to be in the top 10 percent of this nation, have had the opportunity to be educated, to have gained very important and requisite skills to function in a highly automated and technological society. We are depending on you to help to bring about through your skills and your talents an amelioration of the human condition. I know that your concerns may be more technical, more involved in scientific pursuits. I know technology is advancing so quickly, you may worry that if you go out for lunch, you will have to be retrained when you get back.

But let's talk about you as people—not even graduates, not people that are going to be acquiring some of the highest degrees that will be offered this year in the United States of America. Let's talk about you as citizens and as spouses and as parents and as members of our global community.

Diane M. Peterson, (left) permanent president of the Class of 1984, announced pledges of $13,000 for a Class of 1984 Scholarship and a $3,700 gift, which will be combined with $5,100 from the Class of 1934 to buy ice skates for the Athletics Center rink.



They let the raiment fit the clime, or climb, as the case may be: subtracting academic garb helped cope with the heat; but adding a doctoral hood, portent of future achievement, is cause for joy at any temperature. (One new Ph.D. was overheard to say, however, "I'll never do this again—never!")

I am not suggesting that you drop everything to join the fight for equality, nor am I asking each of you to abandon all thoughts of your personal reward or comfort or achievement in your chosen profession. You do not need to march out barefoot into the snows of winter to combat all the ills of this world. I *am* asking you to recognize and act upon basic humanitarian responsibilities.

As a citizen, of course you must be an active and informed and regular voter. In addition, I hope that you will make all of your views on public issues known, not just in the voting booth, but more frequently in meetings and in letters and by the telephone.

I even dare to hope that some of you will join with me in seeking to restore public leadership—leadership that exemplifies profiles in courage in this great nation, which is committed to the needy and the disadvantaged.

I must say that fewer events in my life have been more difficult for me to watch than the Reagan administration's replacement of compassionate egalitarian government with government pledged to greed and selfishness and the ascendancy of the rich and the advantaged in this country. That is all I better say on that subject. Once I get started, it might be time to order pizza and settle in for a tirade; I will spare you, however. My opposition to the President's policies is no secret to anyone here.

Family Values Affirmed

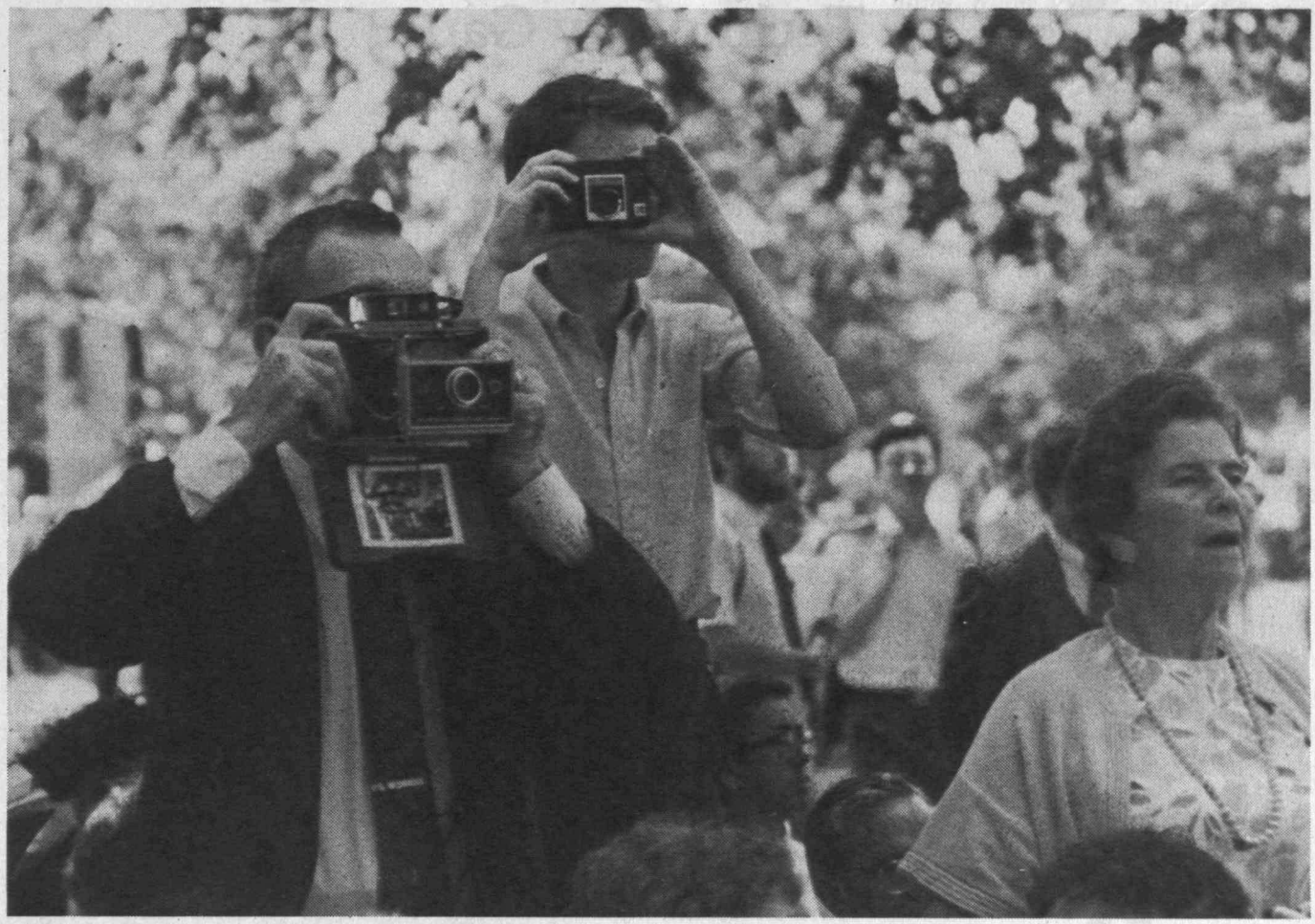
Let's get back to you and finish with you. Let me mention just a few of my hopes for each of you as husbands and as wives and as fathers and mothers. I have been reading that people today are beginning once again to turn away from the cult of narcissism, turning away from the "me-generation," and I am glad of it.

I have been encouraged by reports of spouses more committed to enduring relationships. I have been happy to hear about young people caring just a bit more about family and community. It has been good news that many people are accepting more responsibility for others, a kind of responsibility which has needed to accompany the new personal freedoms we gained during the past twenty years from the easing of rigid conformity and old stereotypes.

In our own homes, we are responsible for listening and for sharing and for caring. If we have children, we have an even more crucial responsibility to give them the time and the attention and the affection they need.

Whatever M.I.T. may be, it is the people that are its most important asset.

FROM TECHNIQUE '84



If you, if *we* truly are concerned about the education and well-being of the next generation, we are going to have to do better as parents. The fact that schools provide only part of a child's education, the fact that schools alone cannot teach and nurture our youngsters, really is a fact. It is not just an easy excuse from the teacher or the principal or the school superintendent. The well-rounded education of our children is a responsibility we cannot and must not shirk.

I have talked a lot to you about responsibility. You understand that I am not speaking about a depressing heavy burden of unending obligations. I am speaking instead of the joy-producing, world-bettering responsibility which lifts far more burdens than it imposes.

I have been talking about vibrant democracy; I have been talking about healthy marriages; I have been talking about happy children; and I have been talking about making a kind of world where those children can sit at future graduations—their own and their childrens'—and look back at times of greater equality, greater prosperity, and unbroken years of world peace.

Search Lights and Torches

Finally, you who are graduating here today are the footsoldiers of the future. Your education has been a complete failure if it has failed to open your hearts to enlightenment. Some of you even may become leaders in helping to create a better world that we all hope for.

Thus, shining the searchlights of science into the secrets of the universe, and at the same time holding high the torch of freedom, equality and peace, each of you can help build a paradise on earth.

The time has come when you who are skilled and have ability can no longer sit and be the complacent, passive recipients of whatever the education and the politics of the nation—a nation as great as the United States of America—may decree for us. If you have live consciences, many of you can become profiles in courage. You will stand up and be counted. You will even have the audacity to forget the conventionalisms and forget traditions when traditions are no longer the answer to the problems that we are groping with in this world. You will do your best deeds, think your best thoughts, looking only to God, whoever your God is.

Congratulations. May God guide you and protect you. I am looking to you to become some of the future dynamic leaders of the greatest country in this world. □

日本科学技術

Bridging the U.S.-Nippon Technology Gap

A New Program Puts M.I.T. Students in Japan to Work and Learn

The dispatches indicate that it is a great success: the first round of interns working and studying in Japanese university and industrial research laboratories under the M.I.T.-Japan Science and Technology Program are coming to appreciate and impress their hosts.

The interns, six M.I.T. graduates now completing their first 12 months in Japan, are unique, according to D. Eleanor Westney. Westney is assistant professor of international management in the Sloan School and acting director of the M.I.T.-Japan S & T Program. She says that the interns are the vanguard of the only co-ordinated U.S. program to nurture the human skills needed to keep abreast of developments in Japanese science and technology which underlie that country's much-touted business success.

The M.I.T. program aims to boost two-way communication between the U.S. and Japan by building a cadre of technologically skilled professionals with language training, cultural understanding and research experience in Japan, Westney says. The fact that the interns have been doing excellent work, and that there are more opportunities opening up in Japanese universities and industries than there are available interns, can only help to ensure a long run for the fledgling enterprise.

While Professor Richard J. Samuels, Ph.D.'80, founder of the program, is finishing up a year conducting research in Japan and monitoring the first interns, Westney and her administrative assistant Alice Peattie are busy preparing a second group to go soon and recruiting a group of future interns who have the special personality and commitment to fit them for Japan's reserved, formal culture.

In the years preceding the internship, these students must acquire a comfortable facility in Japanese language and culture and enough technical experience to make them welcome in research settings.

Tapping Visitors' Knowledge

There are no courses in Japanese at M.I.T., so students either struggle in the heavily literary program at Harvard or find summer language training elsewhere. The cultural familiarization is taken care of in weekly seminars at M.I.T. on the

Japan's postage stamps reflect the integration of traditional culture and modern technology that is a vital lesson for students in the M.I.T.-Japan Science and Technology Program. As a guest at his professor's maiko-geisha club (photo below), Peter Poole, who completes a year in Japan this summer, demonstrates one aspect of this important lesson.

practical aspects of living and working in Japan. Seminar leaders include Westney, Peattie, and Japanese members of the M.I.T. community, among them the 150 visiting scientists and engineers typically in Cambridge at any given time. (Professor Westney has spent nearly three years in Japan, the first year as hostess at the Canadian government pavilion at Expo '70 in Osaka, and Peattie lived for nine years in Japan while her husband was on a diplomatic posting there.)

Interns in the M.I.T.-Japan S & T Program need courage, too. For in many respects the year in Japan is a year out of the professional mainstream. Westney observes that women students seem more willing to take that risk than men, yet it is the women who experience the greatest cultural pressures when they move to Japan.

The problem is that many Japanese women, if they work outside the home at all, are considered "office flowers," a title they earn with exquisite grooming and attire. Not men and certainly not office flowers, "foreign women from M.I.T. form a curious third species," Westney says.

Patricia Cullen, '82, who is interning as a researcher in the Hitachi Central Laboratory in Tokyo, is "a test case," she writes. "My superiors have made it clear that I am different than the Japanese women, and they want to see how an American woman scientist works and behaves."

Cullen is providing ample answers to their question. Working with state-of-the-art molecular beam equipment to grow nickel disilicide semiconducting layers on silicon, she had her name on two papers presented at a Japanese applied physics conference in April, and she expected to give a paper to an international group this summer.

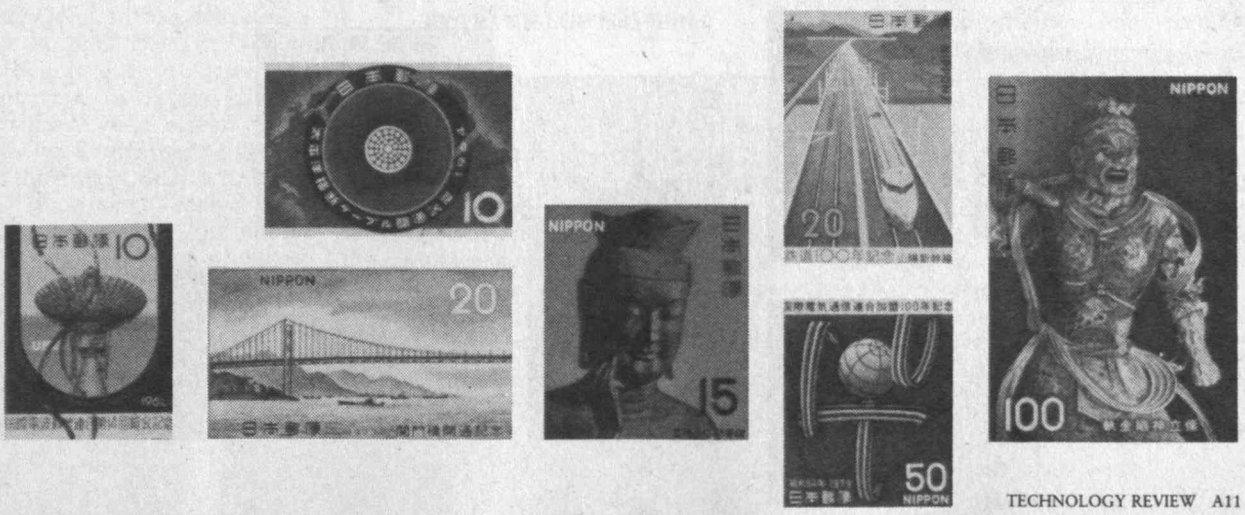
"They expect a very high level of work out of me, higher than normal for a new employee, because I am here just for a year," Cullen wrote to Alice Peattie. Samuels reports from Japan that Hitachi is very enthusiastic about Cullen's work and wants other M.I.T. interns.

"A Banana in a Coal Scuttle"

Tanya Sienko, '82, is also winning high praise from her Japanese mentors, Samuels reports. She originally enrolled in a nondegree program in electrical engineering at Tokyo University. Sienko survived the infamous Japanese "examination hell"—with the help of Goldstein's *Classical Mechanics*—and was admitted to the master's program at Tokyo, the country's top national university. It is an extraordinary achievement for a Western student.

"Learn Japanese," is Sienko's terse advice for would-be M.I.T.-Japan interns. "No matter how much you think the Japanese know English, you will find that it is invariably less than you think." Sienko lives with a Japanese family and speaks Japanese all the time.

She reports that women are al-



"If you stand around looking lost and helpless enough, someone will volunteer some help."

lowed a little more freedom if they are students, so long as they abide by the subtle codes that govern student group activities. "Remember that you are conspicuous—a banana in a coal scuttle," she cautions. Among Sienko's frustrations in daily life in Japan: colleagues who never understand your jokes; buildings with no insulation or central heat; spending the entire winter with a cold; beverages limited to beer, sake, orange soda, or tea; and routinely being lost on the trains.

On the other hand, Sienko has plenty of rewards, too. She has won a very generous Monbusho Scholarship from the Japanese government. Her research group really appreciates her determination to hang out with them, and to resist the temptation to gravitate to other *gaijin* (foreigners). She can buy almost all her favorite American products and brands—they're just expensive. And about the trains: "If you stand around looking lost and helpless enough, someone will volunteer some help."

Sienko also reports a great selection of books in English, even science fiction, a not-inconsequential bit of information for someone contemplating an entire year of culture upheaval.

Bring Your Motorcycle License

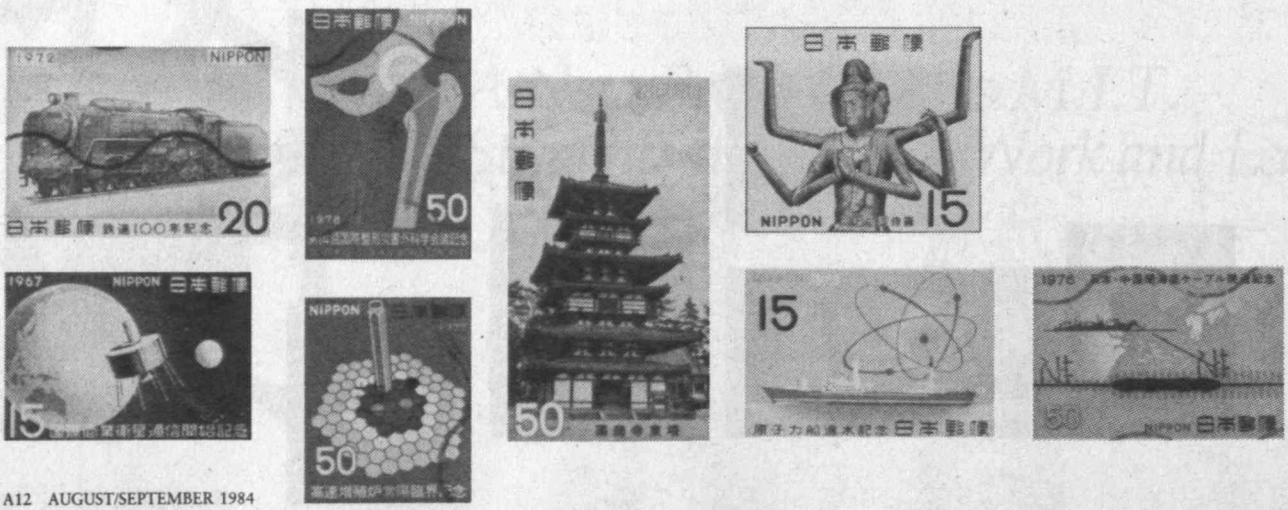
Peter Poole, who interrupted his graduate studies in the M.I.T. Technology and Policy Program to join in a new program for international graduate engineers at Kyoto University, describes with enthusiasm his experience as a civil engineering student there—almost an "industrial travelogue," he says. There are frequent trips to observe the billion-dollar civil projects that abound in the Kyoto area.

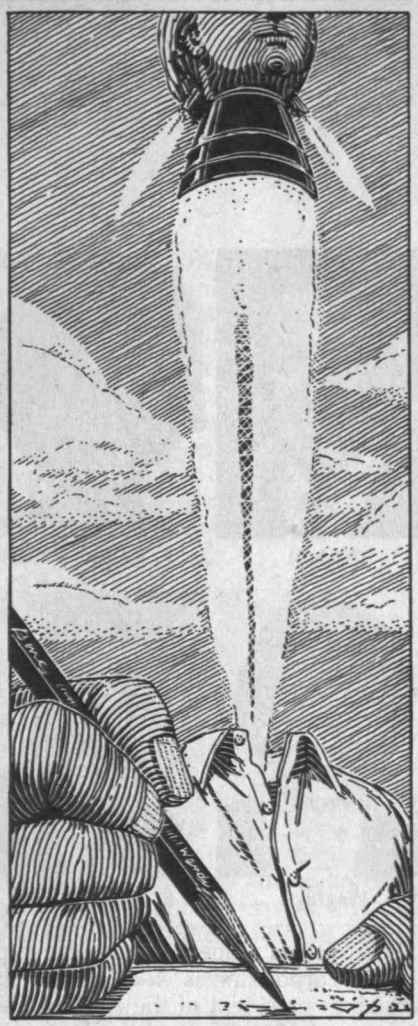
Poole is discovering the differences in learning style—the small amount of interdepartmental interaction, the "groupiness" of Japanese graduate students, and the distance and formality that characterize the relations between faculty and students.

As a result of the latter, Poole interacts primarily with the associate professor and research associates. But he finds appearances can be deceiving: his advisor, by virtue of his stature as a full professor and the government position that is inherent in professorships at national universities in Japan, can optimize Poole's research environment simply by introducing him in the right places.

Though Poole describes the Shugakuin International House at Koyto University as "unsurpassed in Japan," it's cold in the winter and reportedly hot and muggy in the summer. But he writes of the "exhilarating . . . freedom: of traveling by motorbike and hiking, free from crowds, trains, and buses." He recommends that interns bring motorcycle licenses, hiking boots, and sleeping bags.

Two goals are now at the top of Eleanor Westney's agenda: placing the first group of former interns in American jobs where their grasp of Japanese technology can be made to count, and raising additional funding to support special language training and to help Japanese universities and industries meet the costs of bringing highly qualified interns into their laboratories.—*S.L* □





Project Goddard: Stuck Between a Rocket and a Hard Place

BY FRANK LOWENSTEIN

It looks rather unimpressive. Made from a single copper rod and an assortment of tubing, and only slightly larger than a good-sized coffee mug, this rocket engine is far removed from the flash and spectacle of Apollo and Gemini, Mercury and Mariner. But although it was built with essentially no resources by a group of M.I.T. undergraduates, it shares with its larger cousins the complexity of high power fuels and high energy physics. And, if the students accomplish their goals, an engine similar to this one will push the world's first student-built satellite into orbit.

After a year-and-a-half of intermittent work, Project Goddard has yet to achieve a successful test firing of the experimental engine, but it has already added to the education of many students. They have handled all aspects of the project, from feasibility studies and initial design through fund-raising, machining the engine, and testing. This breadth of experience is "something you wouldn't normally see on a large scale project because you'd just be working on a small part of it," explains Edwin Seidewitz, '84, who has worked on the project since its inception.

Some 25 to 30 students were attracted to the project during the last Independent Activities Period, five to six work on it through the school term, and one or two students are pressing on through the summer.

Vincent Natoli, '84, worked on designing the prototype engine a year before he studied rocket propulsion. Last term he finally came up against the theory behind what he had designed and found "It was nothing! I breezed through the course."

Not all Project Goddard participants want to go into rocketry, explains Mike Phillips, a junior who became interested in the project this year, "but the lessons we learn from this project can be applied to any engineering project."

Fire and Ice

So far Project Goddard has delivered a large lesson in patience. Participants completed their prototype engine last summer, but as of *Technology Review*'s press time had not yet achieved a successful test firing. Remembering the initial hopes of the project, Seidewitz looks thoughtful. "It certainly seemed a lot easier then than it does now," he muses.

Some of Project Goddard's problems with the engine have been due to inexperience. "The first time we tried it was kind of ridiculous," recalls Professor of Aeronautics and Astronautics Manuel Martinez-Sanchez, the group's faculty advisor. After setting up the blast shields and running 10-foot lines to the liquid oxygen and fuel tanks, the participants retreated behind a blast-proof door, opened the values, and waited for the liquid fuels to enter the combustion chamber. Instead there was only a prolonged hissing. The liquid oxygen vaporized while traveling through the long fuel lines, and nothing happened.

That problem was solved by cooling the lines with liquid nitrogen, but still the engine sat lifeless. As Phillips explains the problem, "You can put fuel and oxygen and a flame together, and sometimes they don't burn."

Goals Undimmed by Difficulties

Working with another student, Phillips will continue trying to get the prototype to work this summer, and while he remains hopeful, he admits that "if we don't achieve ignition, I don't know what the project's going to do."

If they do achieve ignition and are able to test the engine, then the project will move into its next phase–constructing and testing an actual prototype of the third stage of the rocket that the students hope to launch. For this task Project Goddard would probably have to use government facilities to launch the rocket and might have to seek funding outside of M.I.T. Based on corporate response so far, the chances of finding such outside support seem good.

Project Goddard has already received discounts and free materials from a number of companies—as well as an offer of a Redstone rocket. Seidewitz and others thought it would be fun to take such a monster apart and see how it worked, but finding a place to store a 60-foot rocket proved to be an obstacle.

Although Martinez-Sanchez notes that "we want to be humble at this point, because we don't have much to show," the eventual goals of the project are quite ambitious. Ideally Project Goddard would like to put a one kilogram payload into orbit using a three stage rocket. As now designed, the first stage would be powered by a fairly conventional solid-fuel engine, and the upper two by smaller, lighter, liquid-fuel ones. The liquid-fuel engines would be made from an abaltive material that would gradually char away during flight. This would eliminate the need for a cooling system, saving weight.

If Project Goddard succeeds in its initial objectives, participants dream of building a ten-kilogram-payload rocket, which they could rent to corporations that want to test something in space but don't need the elaborate facilities of the space shuttle.

But for now, explains Seidewitz, "we just want to put something up there to show that the technology is far enough along that we can do it. That it's not just the domain of big government any more." □

FRANK LOWENSTEIN is a freelance science writer recently named assistant editor of Oceanus *magazine.*


D. J. Atwood


M. E. Mahoney


R. L. Mitchell


A. F. Roane


M. W. Spellman


R. S. Stata


M. F. Wagley


C. R. Wharton

Corporation Changes

Eight new faces will grace the first meeting of the M.I.T. Corporation of 1984-85 on October 5. The new members, chosen late in the spring:

☐ Donald J. Atwood, '48, executive vice-president of General Motors.

☐ Margaret E. Mahoney, president of the Commonwealth Fund, New York.

☐ Robert L. Mitchell, S.M.'47, vice-chairman of Celanese Corp.

☐ Arlene F. Roane, '83, admissions counsellor, Babson College, Wellesley, Mass.

☐ Mitchell W. Spellman, M.D., dean for medical services, Harvard Medical School.

☐ Raymond S. Stata, '58, president and chairman of Analog Devices, Norwood, Mass.

☐ Mary Frances Wagley, '47, formerly executive director of Episcopal Social Ministries, Baltimore, Md.

☐ Clifton R. Wharton, Jr., chancellor of the State University of New York System, Albany, N.Y.

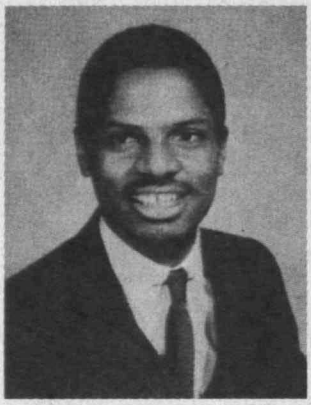
In addition, two term members of the Corporation were elected to life membership: Frank T. Cary, chairman of the Executive Committee of I.B.M., and Edward E. David, Jr., Sc.D.'50, president of Exxon Research and Engineering Co.

Ms. Wagley's one-year membership on the Corporation is ex-officio to her service as president of the Alumni Association in 1984-85; all other new members hold five-year terms. Ms. Roane was nominated for Corporation membership by the three most recent graduating classes, and Messrs. Atwood, Mitchell, and Stata were nominated by the Alumni Association's 1983 National Selection Committee.

Mr. Atwood holds two M.I.T. degrees (S.M.'50) in electrical engineering, and he has been with General Motors—first with Delco—since 1959. Ms. Mahoney, president of the Commonwealth Fund since 1980, was earlier associated with the Carnegie Corp. and vice-president of the Robert Wood Johnson Foundation (1972-80).

Dr. Spellman holds degrees from Dillard, Howard, and the University of Minnesota, and he served on four medical school faculties before joining Harvard in 1978. Mr. Stata is widely known as a spokesman for the interests of high-technology industries; he received bachelor's and master's degrees in electrical engineering from the Institute simultaneously. Dr. Wharton, an economist, was president of Michigan State University from 1970-78 before taking his present post. ☐

Karl Reid: Minority Leader


K. W. Reid

It all came together for Karl W. Reid, '84, last spring as he graduated from M.I.T.:

☐ He was cited by the M.I.T. Office of Minority Education for the highest grade average among black males at the Institute.

☐ He won a Compton Prize for notable contributions to the M.I.T. community as an undergraduate.

☐ Capping it all, he won the chairmanship for 1984-85 of the 3,000-member National Society of Black Engineers, an organization of students at 114 engineering schools throughout the U.S.

His goal in his year as head of the NSBE will be to help cut the "high attrition rate of minority engineering students," says Reid. "At some schools only one-third of those who enter engineering disciplines graduate in four years," he explains. The reasons: the lack of effective academic support systems, insufficient financial aid, and the underrepresentation of minority members among faculty and students.

Campaigning for the top office at the national convention of NSBE last spring in Washington, Reid promised to address those issues by organizing workshops on support programs that have proven successful at various schools; by sponsoring letter-writing campaigns at colleges where financial aid, admissions, and minority faculty recruitment polices are considered to be inadequate; by creating a national outreach program

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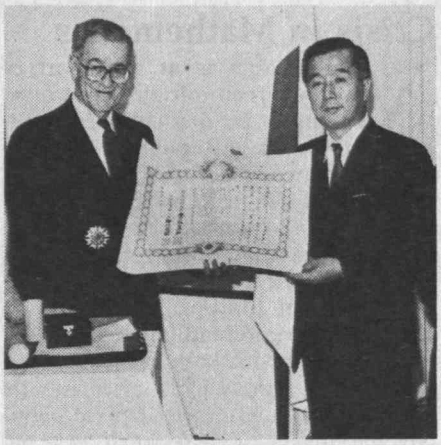

For "meritorious services . . . for the promotion of friendly relations and mutual understanding," Professor Samuel A. Goldblith, '40, vice-president—resource development at M.I.T., receives from Consul General Sadakazau Taniguchi (right) Japan's Second Class of the Order of the Sacred Treasure. The story is made poignant by something the picture does not tell: Captured by the Japanese in the Philippines as a young Army officer in 1942, Goldblith spent four years as a prisoner of war.

Goldblith, Honored by Captors, Calls for Peace

Bitterness and hate would have been easy for Samuel A. Goldblith, '40, after surviving the "Bataan death march" and four years in Japanese prison camps after the fall of the Philippines in 1942. But it didn't happen that way—not for long, at least.

"It's not so much a matter of forgiveness," Goldblith told Robert Cooke of the *Boston Globe* late last spring. "It's whether you look to the past, or you look to the future. The difference is, if you look to the past, it's hate, which brings on war. If you look to the future, it's love, and that brings on peace."

That philosophy brought Goldblith a near-unique honor late last spring: the Second Class of the Order of the Sacred Treasure of Japan, one of the country's highest, given for his efforts on behalf of friendly relations between the U.S. and Japan and—especially—to advance Japanese scientific and technical standards.

Goldblith is vice-president—resource planning at M.I.T., and one of the fruits of his extensive contacts with Japanese industry has been membership by some 50 Japanese companies in the Institute's Industrial Liaison Program. □

NSF Fellows Choose M.I.T.

M.I.T. will enroll more National Science Foundation fellows in 1984-85 than any other U.S. educational institution. And the Institute was third in the number of current students receiving fellowships under the massive NSF program. Of the 540 students chosen for NSF fellowships, 83 (16 percent) will come to M.I.T. next fall for graduate study. Seventy-four will go to Stanford, 50 to the University of California at Berkeley.

Of the 60 students receiving NSF's special minority fellowships, six will come to M.I.T.

Twenty-three members of the Class of 1984 at M.I.T. received NSF fellowships, and of these 13 these will study at M.I.T. next fall. □

Financial Vice-President

A major appointment in the Institute's financial management: James J. Culliton, director of personnel since 1978, has been named vice-president for financial operations.

Culliton studied engineering at the U.S. Naval Academy and served as naval aviator from 1959 to 1964. He came to M.I.T. in 1970 after receiving a master's degree from the Graduate School of Industrial Administration at Carnegie Mellon University and serving with the Ford Foundation.

Culliton succeeds Stuart H. Cowen, who resigned for health-related reasons. President Paul E. Gray, '54, praised Cowen's "long and distinguished service to the Institute and to the cause of higher education on the national scene." □

Breaking Down the Walls Between Language and Literature

When Professor Isabelle de Courtivron was picked for a Harold E. Edgerton Award for excellence in teaching last spring, Lois Coit of the Christian Science Monitor *was intrigued: a teacher of French being thus honored at M.I.T.? She soon enough discovered the answer: enrollment in French courses has gone up 80 percent in five years, and the number of undergraduates choosing French as the focus of their humanities studies has jumped from 33 to 103. Most of her colleagues give de Courtivron major credit for these changes, and here is what Coit wrote:*

Professor de Courtivron is an energetic woman, born in Paris and educated in the U.S., whose hands speak French even with the language coming from her mouth is perfect English. She is a scholar of 20th-century French women writers, an effective teacher in the classroom, and since 1978 an important part of the Institute's efforts to rejuvenate its foreign-language programs.

"A lot of the burden of getting us on the right course fell on her shoulders,"' says Professor Edward Baron Turk, head of foreign languages and literatures. "It was her commitment, her infectious enthusiasm that helped us all believe in it."

What M.I.T. has done to its foreign language and literature curriculum is to break down the division traditionally made in most colleges between the language and the literature courses, mixing a large measure of cultural material into all its offerings.

"You don't have separate little blocks," says de Courtivron. "It is not: 'You learn the grammer this year, and then we hand you Moliere.' "

Unlike many universities, where separate staffs teach language and literature, at M.I.T. everyone teaches both.

Teaching the vocabulary and the syntax is only a small part of teaching a foreign language, de Courtivron says.

"A language is never separate from the way a culture perceives the world," she notes. "One of the real problems with Americans is that they really approach the world without historical, political, and linguistic understanding." In her view, understanding another culture also helps students understand their own culture better.

I. de Courtivron

And so, while her French IV students are learning the subjunctive, they will also, for instance, be reading articles in French about colonialism and discussing French attitudes toward colonialism as well as their own—all in French of course.

It is important to address subjects in class that are interesting to college students, de Courtivron says, and not to hand students what she calls "the baby stuff" often used in teaching languages.

"I think it so badly done. It is done on the croissant-and-cafe-au-lait level," she observes. "French culture has always been reduced to croissants, the guy with the beret on his head, and fashion. And really there is much more than that."

Her classes are fast-paced. She teases a student who is wearing a suit and tie for a job interview and gets the class to discuss and vote on whether or not he should take the job. She rolls her eyes dramatically at a tardy student before moving on with the day's lesson.

"Fun has to be part of it," she says. □

Crisis in Mathematics

Mathematics is at the heart of "high technology," but U.S. support for mathematics is lagging—an "alarming" failure, says Edward E. David, Jr., Sc.D.'50. David is president of Exxon Research and Engineering Co., and reported late last spring as chairman of a special panel of the National Research Council.

"At present funding levels," David told the American Mathematical Society in a preview of his panel's report, "the mathematics community is losing its ability to renew itself, let alone to maintain the quality of its research. . . . No major field has lost as large a fraction of its federal research support in the last decade and a half," David said.

Mathematicians have mostly themselves to blame for their predicament. "The present situation arose from outside perceptions of a mathematics activity that voyages in such splendid isolation that society can afford to not pay passage in times of budget stringency," David said.

No so, of course: the NRC panel, which included Professor Kenneth Hoffman and President-Emeritus Jerome B. Wiesner of M.I.T., called for doubling federal support for mathematics research during the next five years, from $78 million to $180 million. But it won't happen, David warned, unless mathematics comes once more to be perceived as "an essential contributor to science and technology. . . . The renewal of mathematics depends upon unified action by the mathematics community . . . a united front that includes every one of the mathematical sciences." □

Continued from page A14

to encourage young people to become scientists and engineers; by seeking corporate support through scholarships for minority youth; and by spotlighting the "good works of NSBE to promote a positive national image."

While he's doing all this next year, Reid will also be continuing his career as a graduate student in materials science and engineering at M.I.T. His formula for success, suggested to him by his parents: "Never settle for average, because average isn't enough." □

Classes

The First Olympics: An Olive Branch for Thomas P. Curtis, '94

In 1896 the 13-man U.S. team took 9 of 12 first-place medals. Included in the teams sent by Princeton University and the Boston Athletic Association were (standing above, left) T. E. Burke, Boston University Law School; T. P. Curtis, '94; E. H. Clark, Harvard; (seated, left) W. W. Hoyt, Harvard; Sumner Paine, Harvard; Coach John Graham; J. B. Paine, Harvard; and Arthur Blake, Harvard.

"It was nip and tuck from start to finish, both the Englishman and myself clearing the tenth hurdle abreast. I beat him by a scant two feet," said Thomas P. Curtis, '94, of the 110-meter hurdles race at the first Olympics in 1896 at Athens, Greece. Although he is the only M.I.T. person known to win an Olympic event, Joseph L. Levis, '26, won a silver medal in fencing at the 1932 Olympics in Los Angeles and Ralph L. Evans, Jr., '48, won a silver medal in sailing at the 1948 Olympics in England.

Curtis' story was portrayed in an NBC mini-series last May. He was part of a 13-man contingent from the U.S. sent by the Boston Athletic Association. The decision to enter was made at the last minute, and the athletes trained on the boat's deck enroute to Naples.

In Athens cheering crowds, bands, and a mayoral committee greeted the U.S. team. Sandwiched by the bands, the athletes walked through the streets to City Hall. The next morning they took carriages to the stadium where 112,000 (including Greece's king and royal family), gathered to watch the games.—*S.K.*

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Aristine L. Coker writes to say that her father, **Norman A. Lougee**, died September 16, 1982 at the age of 92. He was formerly associated with General Electric in Schenectady. While there he designed the oxide film lightning arrester and the pellet lightning arrester. Both became standards for more than 25 years. He also worked closely with Charles P. Steinmetz on the design of the first lightning generator. Both Albert Einstein and Thomas Edison saw the generator demonstrated when they visited Steinmetz. More recently Lougee was employed with Stone and Webster Engineering Corp. in Boston and New York. He later served as president of the consulting firm of N.A. Lougee and Co.

Mrs. Coker adds, "Mother died on January 30, 1984. While neither of my brothers went to M.I.T., my husband got his master's there in 1947 and my son-in-law graduated in 1978. It's a great school."—**Gardner C. George**, Secretary, 3960 N.W. 11 St., Coconut Creek, FL 33066

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From a mailing of 21 letters to classmates about our 70th reunion, we had 15 responses. As of late May, five or six of us expected to be in Cambridge on June 7-8. Messages from the other classmates were mostly that problems of health or travel would keep them away.—**Charles H. Chatfield,** Secretary, 177 Steele Rd., West Hartford, CT 06119

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Fred Vogel reports on the memorable time he had when he attended the Class of 1918 reunion last June 1983. He enjoyed visiting relatives and going to places where he had lived—Bangor, Mt. Kataliden, Bar Harbor, and Milo, Maine, seeing a moose and her calf, deer, and on and on. He had never seen the new buildings, only the ones on Boylston Street and Copley Square. He took the tours, saw Endicott House, and attended all the affairs set up by the Class of 1918. Seven or eight older alumni attended, but he didn't feel they were quite as active as he is. He reached 91 years on April 15, and we congratulate him way down in Clearwater, Fla.! . . . I am certain many more of you '15ers have reached 91 and better, including **George Easter** who had a birthday on June 27. . . . **Francis Hann** sends his wishes to the Class Supreme from Beverly Hills, Calif. . . . I cannot express how wonderful I feel when I receive tidings from each one of you—keep your notes (short or long) coming.

Loring Hall recalls how the president, dean, and bursar were so easily accessible and easy to talk to on a one-to-one basis when he was at M.I.T. Professors were friends and role models as well as teachers, he says, and your classmates found time for non-academic activities.

It is sad to report that **Wayne D. Bradley**, former owner of Moosilauke Inn in Warren, Conn., passed away. . . . Also **Henry J. Lucey** passed away, after 65 years of married life. He worked at E.B. Badger Co. of Boston and United Chemical Co. of New York. One cute diary note of **Loring Hall**'s to close with:

November 15, 1912: At the physics lecture today I had to sit beside Mary Plummer, our co-ed. The fellows had a lot of fun at my expense. Walked in town with **Seward Highley** and Dick Hefler.

Loring adds, "If **Mary Plummer Rice** happens to read the above entry, I hope she will forgive me for the inference that I didn't like to sit beside her. The diary says 'had to' but doesn't explain why. The jokes by our classmates can only be explained by the fact that co-eds at M.I.T. in 1912 were scarce and attracted a disproportionate amount of attention. Perhaps there was a little bit of envy involved. We can only speculate at this distance."—**Joyce Brado**, Secretary, 491 Davison Rd., Apt. 9, Lockport, NY 14094

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This is being written in early June, the time of reunions and it brings back memories of our glorious 50th reunion. One of the little-known developments from the record-breaking 50-year class gift was a substantial gift by an anonymous donor who designated that his gift be used to give financial assistance and, as the fund grew, fellowships. Recipients would demonstrate the potential "for successfully directing and coordinating the activities of specialists in various fields, having a broad general knowledge of life's activities in relation to technical developments; knowledge and experience in the methods and processes of research in depth in a given field of competence; the ability to command the respect and confidence of others, largely the result of quiet self-confidence based on sound knowledge of one's capabilities; an intense desire to create; fearless and anxious to attack difficult problems; with a high order of initiative; and an intense desire to produce a maximum in his lifetime by adjusting the intensity of work to his physical stamina, and with a firm determination to continue learning throughout life." This is known as the Hugh Hampton Young Memorial Fund Fellowship. Since our 50th the class of 1916 has been involved with the organizing and continuing of a council to oversee the activities of this fund and the screening, interviewing, and selection of recipients of awards and fellowships.

Joe Baker, Steve Brophy, and **Irv McDaniel** were the original council members. **Ralph Fletcher, Francis Stern,** and **Barney Gordon** followed them. Barney is the sole remaining "16er" on the council and now shares this responsibility with his son, Gene Gordon, **Bob O'Brien, Tom Weil, and Paul Duff**'s son, John Duff. Last week, the council conducted its interviews for awards for the school year 1984-85. As usual the quality of the candidates was extraordinary and it was frustrating not to be able to give awards to all of them. Perhaps some day other donors will add to the Hugh Hampton Young Memorial Fund and thereby make available greater financial assistance and encouragement to very worthy and usually very needy "individuals of great breadth and vision."

We are happy to report that **Paul Duff** celebrates his 90th in July and **Barney Gordon** his 90th birthday in September.—**Bob O'Brien,** Acting Secretary, H.E. Fletcher Co., Groton Rd., West Chelmsford, MA 01863

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Kingsley A. Gillespie died on April 30 after suffering a stroke at his home in Naples, Fla. He had moved to Naples only recently from Stamford, Conn., where he was born and had a very active business life.—**Walter J. Beadle,** Secretary, Kendal at Longwood, Box 217, Kennett Square, PA

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Mary Helen Haecker, daughter of **Stephen A. Hoye**, says that her father is living at the Swiss Home, 53 Mountain Ave., Mt. Kisco, NY 10549 and would like very much to hear from classmates. . . . A most welcome note from **Len Levine**: "On May 7 **Eli Berman** and I attended the M.I.T. Alumni Telethon Drive in Building 10. The two of us were the oldest in a group of about 40 who called all over the country. One call I made to a member of 1919 in California amazed me. He was a retired admiral and wanted to know if he could leave a sum to M.I.T. that could be established in perpetuity. He said he was considering one-to-two million dollars. After I got my breath back, I assured him it could be done."

It is with sadness that I record at this late date the passing of **Herb McNary** on May 8, 1983. An attorney and an engineer, he was executive manager of the Boston Board of Fire Underwriters from 1948 until his retirement in 1978. He was also a freelance writer for newspapers and magazines. He created the Fire Marshal Plan, a plan adopted by the public schools of Boston (and copied by many other cities) to introduce grade school children to fire protection and prevention. Herb was a most loyal member of the class. It was my pleasure to have worked closely with him these many years. . . . Regretfully I submit notice of the death of **John T. Kiley** on April 7, 1984. He was also a loyal classmate who worked in support of the Institute. For 59 years John was president of the James A. Kiley Co., makers of specialty truck bodies in Somerville. After graduating simultaneously from Harvard and M.I.T., he worked for the federal government's Bureau of Standards. He later joined Westinghouse Electric as an electrical engineer and in 1920 went to work for the company founded by his father in 1890, becoming its president in 1925.

One cheerful note, yesterday May 27th—there was a meeting of the Cardinal and Gray Society at Endicott House. This group is a development of our September mini reunions. It includes all classes who have had their Fiftieth Reunion. It has grown—it meets twice a year in May and October at the Endicott House. It now has an average attendance of about one hundred. 1918 was represented by **Gladys** and **Len Levine**, Dolly and **Eli Berman**, **Hazel Fletcher**, and Selima and **Max Seltzer**. The talk by Professor Gerald Wilson was inspiring in discussing the challenge to M.I.T. graduates and the use of computers in the teaching process for undergraduates.
—**Max Seltzer**, Secretary, 1443 Beacon Street, Brookline, MA 02146; **Leonard Levine**, Assistant Secretary, 599 Washington Street, Brookline, MA 02146

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Our class began with 835 freshmen; as seniors there were 296 registered; and at this time to the best of our knowledge there are 64 living classmates. At this writing we stand only days away from our 65th reunion. We expect at least 14 to attend—eight classmates, two wives, and four guests. Having in mind the above statistics and the advanced ages of our mates, we think it is a pretty good showing. A later issue of the *Review* will record the names of those attending and will inform you of all the goings on.

We had a good number of responses to our final reunion reminder. Many wanted to attend but for various reasons decided not to do so. Among these were **Louis Grayson,** who is prevented by recent surgery, **Abraham Williams** from Honduras, and **Aubrey Amos** from San Francisco who with his wife made a test case by going to Hawaii, then deciding Cambridge would be just too much. **Timothy Shea** decided not to risk it, and **Francis Weiskittel** said he may come if he gets back from Africa in time. Two reminders were returned as undeliverable, **Leo Kelley** and **James Strong**. I hope some reader has their latest addresses.

We regret to report the death of **George B. Hirsch** on June 17, 1983 and **Henry L. Cassidy** in 1975. If we get particulars, we will write more.

Here's hoping you all have a lovely summer. Would appreciate a few words about you for future notes.—**W.O. Langille,** Secretary, Box 144, Gladstone, NJ 07934

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Welcome word from **George Des Marais**. Because he and Lois spent the winter in Ohio with his daughter's family, he missed the account of **Norrie Abbott**'s death. George and Norrie served in the same company at Fort Monroe in 1918. He

was "an outstanding man," says George. George is justly proud of his six grandchildren who hold seven degrees. More power to George who asserts that there is "not enough time to do all we would like to do." He promises to be in touch later, and we shall hope to see him at the 65th.

Donald Groves of Duarte, Calif. died on February 3, 1984. . . . **Ed McCarthy** died in 1981. He lived in Oelwein, Iowa, and was at one time its mayor. A loyal and active classmate, he will be missed.—**Harold Bugbee,** Secretary, 21 Everell Rd., Winchester, MA 01890

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We have little class news this month—we need input from all of you. Your secretary has completed (mid-May) the move to Albany and is glad to have that job behind him. My Betty is in a nursing home six miles away and I visit her almost every day.

Leo Pelkus writes that Eleanor (Mrs. **Donald) Morse** died on April 27 after a long bout with Alzheimer's Disease. A memorial service was held on May 11. Eleanor was a portrait artist, active in gardening circles, and a graduate of the Boston Museum of Fine Arts School. . . . **Don Morse** writes that Winifred (Mrs. **Edmund) MacDonald** died on May 6 after being connected for the past year to an oxygen tube. . . . **Frank Whelan** and Don paid their respects at the funeral home. We send our deep sympathy to Don Morse and Ed MacDonald.

A recent address delivered at a Texas meeting of the Newcomer Society dealt with the history of the firm of Freese and Nichols. . . . **Simon W. Freese**, chairman of the board of Freese and Nichols, went to work for the firm of Hawley and Sands in 1922. In 1927 the firm became Hawley and Freese. In the early days the Hawley firm specialized in water supply and sewage treatment, but today Freese and Nichols is also involved in airport, highway, bridge construction, and pollution control. During his career Simon Freese has been involved with work for the Public Works Administration (including a big sewage disposal plant in Chicago), the State Planning Board in Texas, and the Fort Worth Planning Commission. In 1943 he entered war service on the staff of General Eisenhower and became public works administrator in Germany after the war with the rank of lieutenant colonel.

Two deaths of classmates are reported this month: **Edward L. Young** of Westfield, N.J., on December 4, 1983, and Major General **Stanley Scott** of Dallas, Tex., on March 12, 1983. General Scott served in Europe in World War I and was chief of staff of the Persian Gulf Command in World War II.—**Sumner Hayward,** Secretary, Wellspring House E64, Wash. Ave. Exit, Albany, NY 12203; **Josiah D. Crosby,** Assistant Secretary, 3310 Sheffield Cir., Sarasota, FL 33579; **Samuel E. Lunden,** Assistant Secretary, 1149 S. Broadway, Suite B-800, Los Angeles, CA 90015

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A welcome note from **Julian Lovejoy**: "One of my hobbies is amateur radio. If other classmates are enjoying this hobby, please advise me so that we can get together on the air waves. My call is WIBT." . . . **H. Felton Metcalf** of Newmarket, N.H. observes that he has now been retired for 20 years from Westinghouse Electric and Radio Corp. of America. . . . **Ab Johnson** has recovered well from his hip operation of last winter, and as you read these notes he should be at his summer home in Crystal Downs, Mich. Your secretary had a pleasant afternoon visit in April with **Walt Saunders** and his wife at their home in Cape Elizabeth, Maine, and he also made a short call on **Hall Baker** who lives in that area.

Professor Philip S. Khoury, recently appointed to the Class of 1922 Career Development Chair, joined those of 1922 who were present at the Technology Day luncheon in the Athletic Center on June 8. . . . **Bill Elmer** continues his work on sidetracking the metric system. On April 25 he gave an exceptionally well received talk to the M.I.T. Club of Boston on "Uses and Abuses of the Metric System." In a letter to me Bill says, "I reported (to the M.I.T. Club) on my recent research on the subject, which leads me to think the metric debate may be about ended in the final rejection of the system for public use, but continued in use by the scientific community and in foreign trade to a limited extent."

William Palma Dickerman died March 15, 1984 in Taunton Mass. Bill for many years was an outstanding businessman and civic leader in his home town. As president and general manager, he successfully operated the Morton Laundry Co. He was treasurer of the Morton Hospital for 25 years and had been continuously on the board of trustees since 1939. He had also been treasurer of the Taunton Female Charitable Association, the Old Colony Historical Society, and the Taunton Visiting Nurse Association. In addition he was a director of the former United National Bank of Taunton and of the Machine Parts Co. of Providence. He was a trustee of the Taunton Savings Bank and past president of the Segregansett Country Club. I remember Bill particularly well, as we wrote a joint thesis together. He is survived by his wife Alyce (Davison), a son, a daughter, and two grandchildren. . . . **Frederick J. Burt** of Colorado Springs, Colo. died January 21, 1984. Burt, a member of Phi Kappa Sigma, left Tech prior to graduation. Before his retirement he had been vice-president and sales manager of Johnson Fare Box Co. of Chicago. He is survived by his wife Kathleen. Our condolences are extended to the families of these deceased classmates.

A comment to all classmates who are considering sending news to the secretary: your instructions as to what should go in the notes will be strictly followed. As you direct, I will quote, summarize, paraphrase, omit source, or omit entirely. If no instructions, I will exercise best judgment to cause no regret after having written.—**Yardley Chittick**, Secretary, Box 390, Ossipee, NH 03864

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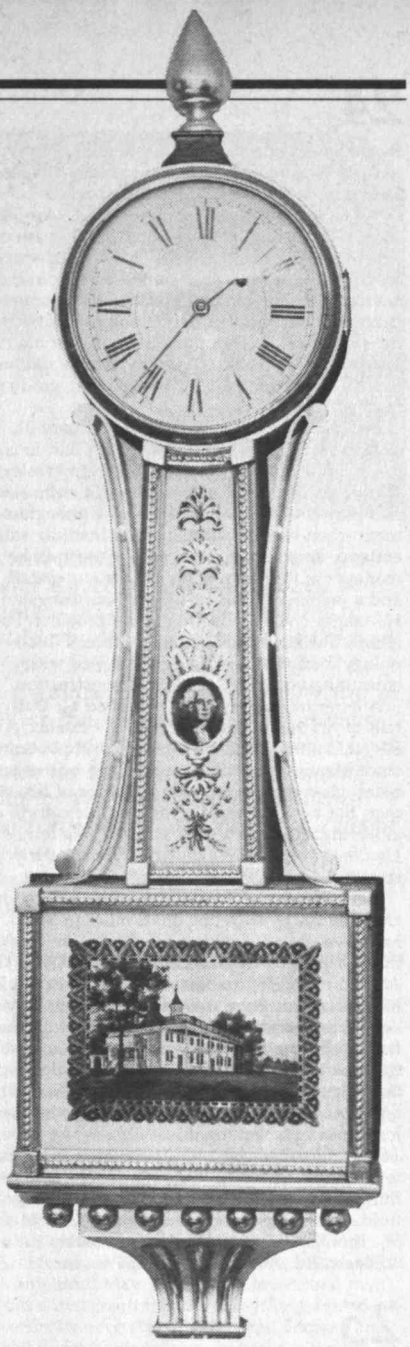
Royal Sterling writes as follows: On April 7 Mary and I drove to the west coast where we were the house guests of Isabelle Skinner. That day Ray and Grace Holden gave a dinner party for Isabelle, Dave Joy, and Mary and me. On April 8 we all attended a picnic given by the M.I.T. Club of Southwest Florida. It was held on the estate of Lucille Hall on Casey Bay. Her husband was Clyde Hall '20, Course II.

Royal and Mary have purchased a large condominium about eight miles north of their home in Vista Pines, on Hutchinson Island. They plan to give up their residence in Rhode Island and move to Florida permanently in October. They now are in Rhode Island for the summer.

William Gurney died November 26, 1983. He graduated with our class in mechanical engineering. For several years he engaged in construction work in Puerto Rico, then returned to the Boston area for a brief time before being sent to Baton Rouge to help start up a new power plant where his work included water treatment and ecology, research, design construction and operation. He retired in 1965 and established W.B. Gurney Associates and operated as a water consultant.

Mrs. Myles Morgan died sometime in 1983. She was the widow of our classmate **Myles Morgan,** Course II.

John Nason died April 1, 1984. He graduated with our class in Business and Engineering Administration. After graduation he joined Westinghouse Electric Corp. and became a buyer for the Lester Branch in Philadelphia. We have no further information about his career.—**Richard H. Frazier,** Secretary-Treasurer, 7 Summit Ave., Winchester, MA 01890



"Any mechanical invention probably had its origin in the making of clocks," says Archer Nickerson, '25, who runs a clock hospital in Duxbury, Mass. Nickerson, who has been studying the styles, history, and mechanisms of clocks for 67 years, says our first clockmakers came to America from England, Holland, and Germany. He claims tower clocks were brought here around 1650 and in 1717 the first tower clock was made in Boston by Benjamin Bagnall.

Roman numerals appeared on clock faces until 1780. The early American banjo clock (above) from Nickerson's collection graced many homes in the 1820s and 1830s. (Photo: Tom Tajima, **Patriot Ledger***)*

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By the time you read this, our famous 60th reunion will have joined the space satellites traveling forever!—details on that event next issue.

We have a newspaper clipping from Mary K., wife of **Roger L. Griffin**, recording his death on February 17, 1984, in Beverly, Mass. following a lengthy illness. He was awarded an S.B. in mechanical engineering and spent his entire career in the leather business. He retired as director of mechanical and development research at the A.C. Lawrence Leather Co., Peabody, Mass. and became a consultant. A son, Roger L. Jr., graduated from M.I.T. in 1954.

Professor **Ranald V. Giles** died January 31, 1984 in Florida. He was awarded his S.B. in civil engineering after receiving a B.S. from Wesleyan University. Ran was an avid baseball enthusiast and played third base on the senior inter-class team when varsity baseball at the Institute was an embryo. At summer camp in East Machias he was manager of the camp team, on the show staff, and a member of the Technicke Four songsters. He taught civil engineering at the Brooklyn Polytechnic Institute and Drexel Institute of Technology for a number of years, coupled with consulting on water supply and construction.

A letter from Mary, wife of **Robert G. Daily**, tells of his death April 23, 1984, in Phoenix, Ariz. He had suffered heart congestion and pneumonia since March, and at 90 was probably one of our oldest class members. Little is known of his career, but he was awarded an S.B. in electrical engineering and circa 1949 was listed as a teacher. He played on the 1924 basketball team, the year that **Stan Cook** was captain.

Herb Stewart performed his version of the Indianapolis 500 by traveling 3,000 miles in Spain, France, and Italy beginning April 19. He went from Madrid by train to Granada and visited the Alhambra palace, the finest large-scale example of Moorish architecture in Spain. Returning to Madrid, he took off by auto for Barcelona and Genoa, Italy. Yearning for mountain travel, he scrambled over the Apennines to Venice and paddled a gondola, driven by mosquitoes. Thence to Sorrento and up north to Rome. He fed the pigeons there for three days, waiting in vain to see the Pope. Tiring of lasagna, he and his son boarded a plane for Boston on May 12, thus completing a test of a European "Drive-A-Car" with his usual sangfroid.—Co-secretaries: **Russ Ambach**, 216 St. Paul St., Brookline, MA 02146; **Herb Stewart**, 8 Pilgrim Rd., Waban, MA 02168

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A 1985 Reunion Planning meeting was held at the M.I.T. Faculty Club on April 26, 1984. The meeting was chaired by our honorary classmate Joe Martori. **Jim Howard** and **Courtenay Worthington** joined me there. A few nights later the three of us plus Ed McLaughlin attended the Alumni Council Meeting and had discussions regarding the 60th reunion which is just around the corner. Hopefully you shortly will be receiving information on plans.

A note from **Clifford Abrahamson** informs us that after trying apartment house living he is going back to living in his own home. His new address: 14 Timber Lane, Cape May, N.J. 08204. This change comes as a surprise to the secretary who is still provided with a Cape Cod address although Clifford for three years has been in Springfield, Pa.

Alan Crowell writes that several months ago he moved to a retirement home at Lake Point Woods, Sarasota, Fla., only five miles from where he has lived the past several years. Alan finds the M.I.T. Club of Sarasota well attended with four meetings a year.

A short letter from **Harrison Browning** brought the sad news that his wife Freda had died suddenly about two years ago. Harrison still finds work keeping him busy much of the time. He has done a fair amount of travelling: four weeks in Argentina and Brazil going all the way down to Tierra Del Fuego; two weeks in the Galapagos Islands; one week sailing off Key West and two weeks in the Algonquin Park in Canada. Also, he finds time to visit his daughter in Oregon. He was heading for Iceland in July and hopes to make the 60th reunion.

It is with sorrow that the deaths of four classmates must be reported. **Paul E. Goble** died at his home in Southern Pines, N.C. on April 24, 1984 following a long illness. Paul worked for several years as a civil engineer in the Chicago area before he joined the Electrolux Corp. He continued with that company until his retirement in 1968 when he moved to Chatham, Mass. While here he was a member of the Power Squadron, the Monomoy Yacht Club, and the Eastward Ho! Country Club. In 1977 he decided to leave Cape Cod and go to Southern Pines. Paul is survived by his wife Helen (Campbell) Goble, a son and two daughters as well as two brothers, Richard B. Goble, M.I.T. 1928, of Kilmarnock, Va. and Sherman M. Goble, Jr. M.I.T. 1931 of Chatham, Mass. He had 12 grandchildren and 11 great-grandchildren.

Belatedly word reaches us of the passing of **Charles F. Norton** of Reno, Nev. on January 12, 1982 and **Robert L. Rockefeller** of Fort Lauderdale, Fla. on May 6, 1982. **Omar C. Hopkins** died in Sun City, Ariz. on March 12, 1984.—**F. Leroy Foster (Doc)**, Secretary, 434 Old Comers Road, P.O. Box 331, North Chatham, MA 02650

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A brief note from **William Goodridge**: "Retired from activity as manufacturer's agent (Electric Test Equipment). Played in an adult marching fireman's band (flute and piccolo). . . . A letter from **Jim Killian**: "The **Robert Dawes** family gave him a party on his 80th birthday on April 8. My wife and I had the pleasure of attending, so M.I.T. was represented among the large group that came from the Dawes enterprises." Bob continues his generous and active interests in M.I.T. sponsoring the Cardinal and Gray Society activities, the most recent of which was the luncheon at the Endicott House on May 27 with Professor Gerald L. Wilson discussing M.I.T. project Athena.

John W. Campbell, '25, life fellow, sends an obituary of his close associate at the General Motors Laboratories for 40 years, **Arthur F. Underwood**, who died April 8 at age 79. He had been manager of the laboratories for 12 years prior to his retirement in 1969, after which he and his wife Dorothy had divided their time between Rochester, Mich., and Palm Springs, Calif. During his distinguished career he received the ASME Mayo S. Hersey Award in 1975 for his contributions to the science of lubrication technology, and was elected to honorary member, ASME's highest status for his contributions to power plant research. He collaborated with medical researchers on efforts resulting in the Dodrill-GMR mechanical heart used as a substitute for the human heart during surgery, and the electric-stethograph. A list of his other achievements and activities in research and civic affairs would run into several pages and would include his work after retirement as consultant to the government and private industry, usually on energy conversion projects.—**William Meehan**, Secretary, 191 Dorset Rd., Waban, MA 02168

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Gjon Mili died in February 1984 after a long illness. At a memorial service at the Time-Life Building on April 11, **Harold E. Edgerton** made the following remarks about his good friend and associate.

"Well do I remember our first contact several years after graduation. Both of us were scheduled to talk about special flash lighting equipment before the Illumination Society meeting held at M.I.T.

"Gjon was first on the program and presented a paper on a mercury-arc-lamp source which was switched onto the line without a ballast. This produced a violent bright flash which could be used as a photography source. The line impedance limited the peak current. Unfortunately, the M.I.T. line was a very low impedence so the peak current went up to an abnormal value and blew the lighting circuit fuses. Darkness prevailed.

"I was next on the program and planned to present a paper about the then new electronic flash system. As I was talking in the dark, someone replaced the fuses, the lights came on and I was then able to show my slides and demonstrations. We had just made our first argon lamps which were a tremendous improvement over the previous temperature-sensitive mercury lamps and air spark gaps.

"Gjon showed a great interest in the strobe system and asked how he could get started. I told him that I would given him a set of strobe lights if he would start a studio in New York City. As many of you know, he did this and later wrote about it in his book, *Photographs and Recollections* (1980, N.Y. Graphic Society).

"Our first trial together was in New York at a friends studio. I hand carried a two-light argon flash unit from Boston, on the train. Mili scorned the use of one light. The resulting photo of a dancer is shown in his book on page 20, and on page 105 of my book, *Electronic Flash, Strobe* (M.I.T. Press).

"Gjon was always wanting to improve his photography technique. For example, after successfully trying the double light unit, he insisted that five lights were a minimum for professional use. So my associates Ken Germeshausen and Herb Grier rushed about and put together a large 5-unit strobe for him. I think he was surprised at the speed. This unit was fine for his studio, an abandoned Chinese restaurant on 23rd St., but was too big for transporting to assignments.

"I was thinking how wonderful it would have been to have had a video tape of Gjon during several of his lecture/demonstrations to our M.I.T. students. He was always very enthusiastic when he talked to them. He would have made a great teacher.

"The numerous exhibits of his marvelous photographs, together with his several books, have made an indelible imprint upon many, many people. We will all miss Gjon Mili."—**Joseph C. Burley**, Secretary, Box 416 RFD #3, Epping, N.H. 03042; **Lawrence B. Grew**, Assistant Secretary, 21 Yowago Ave., Branford, Conn. 06405; **Prentiss I. Cole**, Assistant Secretary, 2150 Webster St., Palo Alto, CA 94301

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In our class notes for July, 1934 (that's right, 1934) there appeared a nicely written account of the wedding of Marie Walters and **George Chatfield**. That event took place on Saturday, April 28 of that year. Exactly 50 years later, on Saturday, April 28, 1984, George and Marie celebrated their special anniversary with a gathering of relatives and friends in Fitchburg, Mass. It was a happy event with socializing, a buffet dinner and entertainment. Daughter Sue and son Don were the entertainers, leading all in the singing of old nostalgic songs. Sue played several favorite classic melodies on the piano and Don gave some of his dramatic excerpts. And, of course, there was much reminiscing. Florence and I were there to enjoy it all. . . . In that same set of 1934 '28 Notes the wedding of Anne Groebler to **Georg Palo** (April 5, 1934) was also reported. So they too have had their 50th anniversary celebration—a lively and memorable occasion with their friends at home. To you, George and Marie, and to you, George and Anne, our hearty congratulations and

Retired mechanical engineer and iceboater Roger Haven, '28 (above), encourages his neighbor youngsters to build iceboats. "This is one of the best projects a child could undertake," he says, pointing to pride of ownership as well as the many facets of workmanship necessary to construct an ice boat. Haven (in boat, far left) was among a group of Fryeburg, Maine, residents who traveled to Long Lake for a bit of boating excitement last February. (Photo: John Patriquin, **Portland Press Herald**)

best wishes!

A full page spread in the Portland, Maine *Press Herald* for February 21, 1984 carried a well illustrated story about **Roger Haven** and his love of ice boating. Roger has built his own ice boats in his home workshop in Fryeburg, Maine. In addition, he has encouraged several young people to build ice boats while he provided the workspace facilities. We were sorry to learn from Roger that Priscilla had to undergo surgery last April but hope and trust that all is going well now.

The May 27 meeting of the Cardinal and Gray Society, held at Endicott House, Dedham, Mass., was well attended by '28ers. Those on hand were: Frannie and **Jim Donovan**, Dorothy (Mrs. **Carney) Goldberg**, Julia and **Paul Martini**, Dorothy and **Gus Rogowski**, Florence and **Walter Smith**. And, by no means least, honorary '28er, Shirley Picardi and husband, Tony. The pleasure of the outdoor patio social hour was enhanced by the magnificent grounds in springtime splendor. There followed an excellent lunch indoors and a very thought provoking talk by Professor Gerald L. Wilson, M.I.T. Dean of Engineering. His views on the state of our national infrastructure, economics and technical capabilities gave us much to think about.

From **Charlie Worthen** in California comes this welcome note: "I had a pleasant surprise a couple of weeks ago. A tall gentleman with a luxuriant mane of white hair came to my door and announced that he was a member of the illustrious Class of 1928. On closer inspection he turned out to be **Gustav Stachelhaus**, although the white hair threw me at first. When I knew him he had red hair. Seems he used to live here in the Villages and still comes over from nearby Sunnyvale to sing in the local church. I was delighted to see him, and we spent a pleasant hour or so recalling old times. A note about me living in the Villages caught his eye (in the class notes) and this inspired the visit."

And speaking of hospitality, during a recent trip to San Diego, Cal., **Jim Donovan** was the overnight guest of Christina and **Howard Batchelder**. And more recently Jim was the host with **Ed Walton** as his guest during Technology Day exercises in Cambridge. We were very sorry to learn that Ed's wife, Dodie, died last January. She was with us for the 55th in June, 1983 and her final illness apparently began at about that time.

A short but cheerful note from **Eleanor Pepper** informs us that she has been elected the first "lady" fellow of National Institute for Architectural Education. . . . **Ken Clark** tells us that he retired in July, 1982 from S.A. Healy Co., Chicago, Ill. after 50 years of service! His work was all in heavy construction—dams, bridges, tunnels, etc. He started as a junior engineer and progressed to company vice president. . . . **Bill Hurst** wants to see the launching of the tall ship *Massachusetts* now under construction in Charlestown, Mass.

With deep regret we must report the death of **Rudolf S. Slaytor** on April 30, 1984. Rudy had been ill with Alzheimers disease for some time and was confined to a nursing home. Having attended University of Arizona before coming to M.I.T., Rudy was a few years older than most of us and this was a little point of pride with him. He graduated in civil engineering and his life work was both in construction and consulting. Besides his wife Verna he leaves his son Henry S. Slaytor, '53, a brother Henry and two grandchildren. To Rudy's family we extend our heartfelt sympathy.—**Walter J. Smith**, Secretary, 37 Dix Street, Winchester, MA 01890

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Louis E. Demakis of Lynn, Mass., retired. He and his wife Julia spend their winters (January through April) in Palm Beach, Fla. and the rest of the year at their home in Lynn. In recent years, they have taken trips to Europe several times and to many parts of the U.S. They are both in good health and are enjoying their retirement years. Since our class was unfortunate enough to graduate at the beginning of the Great Depression, many of us had to look for employment outside the engineering field. In the mid-thirties Louis started a frankfort business on a modest basis and saw it grow into a successful enterprise. At about the same time, I went into the food and catering business in Somerville, Mass. and used to see Louis quite frequently in the Boston market place, each of us buying supplies for our respective businesses. . . . **Richard V. Does** of Dedham, Mass. sends a note full of sadness. He retired from his governmental regulatory job (OSHA, EPA, hazardous waste, etc.) in 1974, but worked part time until May 1982, when he learned that he had a malignant bladder. He lost is wife to cancer in January 1981. He has had surgery and radiation treatment, which damaged his colon. He can drive a car but seldom goes out. One of his sons lives with him and takes care of him. He ends his note: "I keep hoping for better days. Thank you for remembering my 76th birthday." . . . **Earle Erickson** of Burlingame, Calif. celebrates the arrival of their fourth great-grandchild. Earle and his wife Marion plan to attend our 55th reunion. . . . **Malcolm "Mac" Hubbard** writes to thank us for our sympathy on the death his wife Elizabeth. He had hoped to attend our 55th reunion at Chatham Bars but was uanble to due to the responsibilities involved with selling his house. He says, "My daughter wants me to move nearer to her on the north shore, where I have four grandchildren, one great-granddaughter, and lots of friends, but I can not look until this place is settled—title passed and empty. By October, I will either be in good and comfortable shape or kaput."

Chung-Foy Yee of Canton, China writes, "I still remember the luncheon meeting we had at the Faculty Club in 1980, where I had the pleasure of meeting you and a number of other classmates. That was my first visit to M.I.T. in almost a half-century. I have been corresponding with **Bill Baumrucker** regularly, and I met him and his wife twice when they visited China. During my

visit to M.I.T. I also met **Warren M. Walker** and several times visited his home. I am still a professor in the South China Institute of Technology. My wife and I are enjoying fairly good health. I was in the U.S. in March 1983 for the TMS-AIME 112th annual meeting held in Atlanta, Ga. My very best wishes to all the members of our class." . . . Hope (Mrs.) **George D. Rogers,** writes, "I am writing this note as my husband has limited vision and is unable to read or write. He enjoys good TV programs and talking books. He has just celebrated his 87th birthday and appreciated receiving the birthday card from the class. I have always enjoyed 'Salute to Dawn,' a true encouragement to living."

Howard G. Pankratz writes from Riverside, Calif. Howard was in my course (XVII—now defunct) along with **Robert Pride, Len Peskin,** and others. The course was established in 1926, and we were the first graduating class in 1929. Howard reports that he has had to be in bed for the better part of the last three years. He says, "I use the telephone a lot to which my wife Margaret objects because of cost. I have given her a lot of security over the years and tried to teach her to save and invest. She was raised by a mother and two aunts who invented 'Deficit Financing' long before President Roosevelt came into the picture. Now, after 56 years of marriage, she has come close to death twice and it apparently has scared her. I would have liked to have attended our 55th, but the doctors said *NO.* Jim Donovan, '28, who has been a close friend for over 50 years stopped in to visit us in February. Margaret has had more than her share of woes—foot surgery while I was incarcerated for 73 days at the Community Convalescent Center in 1983. Then she fell and broke her wrist and two fingers. We have set up a small hospital here at home. On a happier note, our six grandchildren are a great joy to us. Two competent doctors have told me that my vital signs indicated an ultimate age of 95-100, in spite of several years in the hospital. I don't know if that is good or bad. My very best wishes to all our classmates."

Hunter Rause of Sun City, Ariz. writes, "I thought that my teaching days at Fort Collins were over, but I have been asked to teach the same graduate course in fluid mechanics again this summer. Since I am due at Colorado State on the first of June, I am afraid that our attendance at the 55th will not materialize. But please do give our best wishes to those who make it." . . . **Joe Happel** of Hastings-on-Hudson, N.Y. could not attend our 55th because his youngest daughter Ruth, who has been studying in Africa for her doctorate in anthropology was expected home for a visit at that time. "Our vacation this year was a week in Trinidad and Tabaso," he writes. "There are a great many tropical birds there. The thing to do is to go out to swamp area in Trinidad and watch thousands of scarlet ibises come to roost about sundown. Dottie is busy with Easter music this time of the year. She played *Faure Requem* at a local church a few days ago which I enjoyed very much."

I regret to inform you that three of our classmates have passed away. **Walter A. Key** of Indianapolis, Ind. on April 9, 1983; **Franklin J. Lammers** of Highland Park, Il. on December 11, 1983; and **Walter F. Burke** of Corona Del Mar, Calif., who was killed in an airplane accident on May 7, 1984.—**Karnig S. Dingian,** Secretary, Box 83, Arlington, MA 02174

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Win Hartford is working on environmental problems and urging an unpopular version of the acid rain controversy. Win's position is that the acidification of the Adirondack lakes is primarily due to increased use of motorized recreational vehicles rather than emissions from midwestern power plants. . . . **Angelo Ricciardelli** is one of the diminishing number of classmates who are still working. He is a supervisory electronic engineer at the U.S. Army Foreign Science and Technology Center in Charlottesvile, Va. He says he has "thoughts of retiring, but nothing firm yet." . . . **Les Engler** and his wife now shuttle between Quechee, Vt., and Ft. Lauderdale, Fla. He "is still playing golf and tennis—and counting grandchildren." He recently became president of their 80-apartment co-op in Lauderdale. . . . **Willard Paine** worked for 40 years for Bendix and retired in 1970 as president of the Bendix-Westinghouse Automotive Airbrake subsidiary.. He now lives in a "beautiful 10-room house with a marvelous vista of the Pacific and canyons from the top of Mount Soledad." His hobbies include woodworking in a "good size workshop" and playing a Lowrey organ.

This month we unfortunately have an unusually large number of downbeat items to report: Two of our classmates are now handicapped by Parkinsonism. **Frank Hankin**'s disability is of long standing and caused him to retire from Lockheed in 1967. He reports, "Thanks to 1-dopa and its several variations I manage to get about fairly well," although he uses a wheelchair most of the time. The Hankins now live in Ft. Pierce, Fla. . . . **Ernie Reisner**'s disability is of more recent origin. His wife, Barbara, says that he is now in the Manor Care Nursing Home in Arlington, Va.

We have at hand notices of the deaths of six of our classmates: **John Patrick** on June 20, 1983; **Lawrence Harris** on September 7, 1983; **Dick Boyer** on January 29, 1984; **Leroy Marek** on March 11, 1984; and **Tom O'Connor** and **Haskell Small** on April 16, 1984. Patrick came to M.I.T. from Glasgow, Scotland. He received a master's degree in mechanical engineering in 1930. In the 1950s he worked for Shell Oil in Japan. At the time of his death he was living in Como, Italy. . . . Lawrence Harris lived and worked in Brooklyn, N.Y., all his life. He graduated in Course VIII, and worked as development engineer with Control Instrument Co., engineer at the Brooklyn Navy Yard, and data analyst at the U.S.N. Applied Science Laboratory. . . . Dick Boyer also graduated in Course VIII. He spent much of his career working for Anken Chemical and Film Corp. in Newton, N.J. as director of sales development in the 1950s and later as vice-president. He was living in Pine Grove, Pa., at the time of his death. . . . Leroy Marek received a master's degree in 1930 after earning a B.S. in chemical engineering at the University of Texas. He spent several years at M.I.T. as a faculty member and associate in the laboratory of applied chemistry, then joined Arthur D. Little, where he worked for more than 30 years as chemical engineer, director of the chemical engineering division and senior vice-president. His memberships included A.I.Ch.E., Petroleum Division of A.C.S., and director of the Chemical Fund. He is survived by his wife, Mildred, and a son, Leroy, Jr. . . . Tom O'Connor owned and operated his own construction company, Thomas O'Connor and Co., with headquarters in Canton, Mass., and a branch office in Mamaroneck, N.Y. Tom's company engaged in all types of industrial construction and repair work, including nuclear and fossil-fuel-burning power plants, schools, hospitals and manufacturing facilities. His son Tom, Jr., was vice-president of the company. He is survived by his wife, Frances, three children, and seven grandchildren. . . . After graduating in Course X, Haskell Small taught high school chemistry in Scranton, Pa., until 1940. He was commissioned in the Army in 1941; after active duty during World War II, he joined the reserves, from which he retired in 1970 with the rank of colonel. After the war he worked in various real estate, property management and investment businesses in Washington, D.C. He also engaged in a great many non-business activities, including memberships and directorships in artistic, child welfare, religious and civic organizations, as well as M.I.T. alumni support activities. He is survived by his wife, Ruth, a son, Haskell B., a daughter, Sherry, and three grandchildren.—**Gordon K. Lister,** Secretary, 294B Heritage Village, Southbury, CT.

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Samuel E. Paul writes that he is doing some consultation work in family practice and psychiatry to keep up his medical skills. His hobbies are boating and fishing—he hopes to catch a "big" one. . . . Springfield, Mass. plans to build a stadium, and the mayor appointed **Arthur Marshall** to serve on the Stadium Committee to explore the possible sites, financing, and all levels of community support.

John Brown, Albert O'Neill and I participated in the May M.I.T. Alumni Fund telethon. We had the opportunity to talk to some of our classmates and gleaned the following tid-bits of information.

George Green is retired—likes to paint and stays in Canada six months. . . . **Harry Johnson** serves on the M.I.T. Educational Council. He would like to see a mini-reunion near Cambridge on Technology Day. . . . Professor **Frederick Henderson** is teaching part-time. . . . **Daniel Passov** is semi-retired. Besides golfing, he has three children and ten grandchildren to watch. . . . **Samuel Nordlinger** is retired. Boating is a principal hobby. He has two sons (M.I.T. graduates) and two grandchildren.

We have the sad news that **Alan MacDonnell** died in April after a long illness in Portsmouth, N.H. nursing home. He was a retired executive vice-president of Gilbert and Barker, makers of fuel pumps and burners for heaters. He leaves his wife Bernice and son Robert. . . . We are also sorry to report that Colonel **Albert S. Rice** died on September 1, 1983; that **Leroy Smith, Jr.** died on January 28, 1984; that **Charles Isselhardt** died in 1978. If we get some obituary information, we will pass it on.

Perhaps this is a good time to tell of some of my activities. Last October, my wife Ruth and I took a four-week trip to the Orient. It was a most interesting trip and considerably different from the trip that Uncle Sam gave me 40 years ago. Three thoughts stand out in my mind. Many of the orientals are capable and industrious. We must learn to compete with them. Big cities can be turned around. Twenty odd years ago Singapore was a haven for crime, corruption, and slums. Today it is a clean city—practically no slums, and free of crime and corruption. The thriving city of Hong Kong is worried about 1997 when China will take control. Will they leave the city alone as they say they will? Watch to see who will control the flow of money in and out of Hong Kong.

Just recently Peabody, Mass. had its biggest industrial fire, which made national news. I saw the fire (which started in a building next to ours) heading for us, but the wind miraculously shifted and the fire changed direction. We were the lucky ones. We had severe water damage and a week's interruption, but this was minor compared to the devastated building nearby. It was heart warming to see how so many people and agencies responded to help those companies that were knocked out. WRITE! WRITE! WRITE!—**Melvin Castleman,** Secretary, 163 Beach Bluff Ave., Swampscott, MA 01907

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Do you ever wonder why, with all the names in our class notes, you see so few of the men you knew? You can cure this by sending news of your friends or of yourself. Come on now with the information. If you'll write telling me whom you would like to know about, I'll write them saying you have asked.

This month there was a letter from **Bill Bauer,** Havertown, Penn., via Warren Henderson. He and Helen will spend part of the summer in New England and then go to Europe this fall.

We have a new bride and groom. **Warren Henderson** and **Frances Van Dusen** were married in May. He reports that she is a lovely lady and later this summer they will go to Exeter, N.H.

where Warren and the cows lived. They would like to hear from any of us.

Don Fink has published *Engineers and Electrons*, in connection with the centennial of AIEE. He says it is a coffee table book and covers the subject from Ben Franklin to silicon chips.

Who sent me the information about Tech's 1933 basketball team? **Bill Harper** says it wasn't he—and he has a new post office box number 1080, and he lives in Hattiesburgh, Mississippi, not Michigan. Write again, Bill, and I'll do better. He'd like to hear from friends of 50 years ago.

Times have changed. M.I.T. now has an active and successful frisbee team.

We have lost several members since last we published: **H. Irving Crane,** who was a retired Honeywell man; **Edgar M. Pierce** of Ohio; **Gardner Harvey,** editor of publications for Imperial Chemical Industry, I.C.I.; and **Rein A. Wilson** of Somerville, Mass.

We have followed the wanderings of **Ernesto DeSola** who was active in the business life of San Salvador. After moving to Guatemala, he and Alicia were in Miami visiting their daugther and family and then went to San Francisco.

It will soon be late summer down South and the Whittons will be in the Blue Ridge. Send your mail here and it will be forwarded.

Bob Crane, the corresponding building man reports that he is back in harness doing for some Florida architects the same thing he did for his New England engineers and architects. He and Marge have been back to their summer place on Cape Cod and soon return to Nokomis, Fla., in the Saratoga area.

Let me hear from you.—**Beaumert Whitton,** Acting Secretary, 5150 Sharon Rd., Cottage 112-Sharon Towers, Charlotte, N.C. 28210

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We have word of the death on February 14 of **Albert L. King**. He had quite a varied career. After receiving his degree at M.I.T. in 1934, he studied at the Boston Conservatory of Music and graduated from there in 1938. He turned back to engineering and worked at G.E. in Lynn from 1938 to 1944. As a television engineer, he went with the Mutual Broadcasting System in 1944, worked for the National Broadcasting Co. from 1950 to 1959, and then was chief engineer and technical director of foreign operations for Intercontinental Television from 1959 to 1961. Over the years he was a trumpet player with well-known bands, including those led by Vaughn Monroe, Al Donahue, Bob Crosby, and Tommy Reynolds. He is survived by his mother, two sons, two daughters, and several grandchildren. We offer our condolences to all of his family. Since this is our only news item, let me share with you a few words about my latest travels. I spent two weeks in England in April. They were a good two weeks: the model shows were fun, the National Railway Museum in York always has something different on view, and also in York was the brand-new Jorvik Viking Museum, embodying the results of several years of archeological excavations from the Viking period. York is a fascinating place to wander about. I had the best run of weather I've ever seen in England, almost unbroken sunshine! This past April was the warmest since 1929. The weather made walking a pleasure, and I saw one off beat museum that is a place for almost any engineer. It's at Kew Bridge, near the Gardens, and contains preserved steam engines that were used for pumping water in the London Water Works. Many are of the Cornish beam type (developed originally for the old Cornish tin mines) and date from between 1820 and 1871. Several are in working order, the biggest of which has a 90-inch diameter cylinder—and next to it is a 100-inch engine which is waiting for restoration.—**Robert M. Franklin**, Secretary, P.O. Box 1147, 620 Satucket Rd., Brewster, MA 02631; **George G. Bull**, Assistant Secretary, 4601 N. Park Ave., Apt. 711, Chevy Chase, MD 20815

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Les Brooks writes to explain why he cannot participate in the Class Golf this year: "We are leaving (May 15) for a clockwise zig-zag tour of the West and hope to return by July 15. We plan to hit the scenic spots but, more important, we'll be stopping to see some good friends starting at Las Cruces, N.M., up to Sea Shores in Washington, then down to Boise, Idaho, where our oldest daughter and family live. We are fine. I am rapidly getting disenchanted with mini-farming. The five peach trees of my 16 fruit trees matured with a bang this spring. There is nothing in my books about how to pick and discard well over 200 grape-size peaches per tree and space what remains ten inches apart so the branches won't break when the peaches ripen! After three days of this, I felt like getting an axe and pulling a George Washington!"

Bill Parker also had to cancel the golf for this year, as he and Marjorie will be away most of the summer including trips to New England and Nova Scotia. Bill has developed an interesting hobby that takes the edge off not getting on the golf course: oil painting. He writes, "This is something I have done on and off for 30 years but have never had a real course in painting. The results of getting some expert guidance has made a big improvement. I painted scenery for the first six months, and these last six months I have been painting children, all from photos of our children and grandchildren. I have been getting many favorable comments. Marjorie and I are looking forward to our 50th. She has hers the third week in May, so we'll be able to take them both in next year."

When **Pete Peterson** wrote that he wouldn't be able to play this year due to a slight stroke on his right side, I telephoned him. He sounded great and said he was lucky it had not been more serious. We all wish you the very best W. Earl Peterson! . . . **Al MacAdam** sends the following note along with his entry into the golf tournament: "My physical 'warranty' is running out! Last year my back, this year my neck. You can see from the handicap my golf is going nowhere fast. I'm still an unpaid politico—on the town council and county parks and recreation committee. No more long distance travel—we circumnavigated the globe last spring, so now its home and seeing for the first time many orchids blooming."

I am sorry to report the deaths of three classmates. **Arthur J. Lariviere** died in Worcester March 7, 1984 after a long illness. He was at least a four-time entrepreneur as well as a past president of the Alumni Association. He is survived by his wife Mary, a son, two daughters, and four grandchildren. . . . **George J. Platt** died in Pompano Beach in June 1982. He was a Course XV man and a member of Delta Tau Delta. . . . **John H. Francis** died in Bloomfield, N.J. on November 22, 1983. He is survived by his wife Mary. . . . I hope all of you are having a fine summer.—**Allan Q. Mowatt**, Secretary, 39 Congress St., Apt. 5, Nashua, NH 03062, (603) 883-8517

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This month the mailbag has some welcome contents which I will share with you after the less happy news. The Donatelli Building Co. Inc. of Providence, R.I. reports the death (no date given) of **Louis Testa**. I welcome further information from any of you. . . . Also reported was the death on October 9, 1983 of **Richard S. Robinson**. Dick was associated with Arthur D. Little, Inc. for 23 years and was a vice-president when last I knew. He left ADL in 1971 and had done independent consulting. At ADL he was responsible for R&D in chemical engineering. The information was provided by his son Charles and I do not know who else has survived him. Dick resided at 10 Bay State Rd., in Belmont, MA 02178.

I have previously reported on the frequent trekking of the exuberant **Laddie Reday. Tony Hittl** has sent in an article by Laddie, "Training for Trekking," from an Orange County, Calif., magazine. For the author this includes climbing around Newport's upper bay with a 40-pound pack and heavy boots. Laddie says, "Muscles don't know or care where fitness training takes place, but the rest of the body and the mind can get bored to the point of quitting the program if the march is the same day after day." He claims it pays to train; he was able to outclimb companions 30 years younger! As for Tony, he and Dottie last spring made a trip to India, Hong Kong, and points between.

Dick Halloran sat down at his computer in San Francisco and came forth with the following. "A few months back the class notes looked a little lean so I thought I would forward what gossip I have. . . . **Bill Bullen** is still working hard with his home based consulting business in construction management, mostly estimating the probable cost of all kinds of projects for architects and engineers. He recently added a microcomputer (Victor) to his arsenal. . . . **Arthur Carota** has become a director of Lloyds of London and makes several trips overseas every year. I got to know his son Jim when I was giving a lecture on microcomputer applications in the field at Stanford's graduate course in construction management. Jim is back in Delaware at Dad's business (shopping centers), but he tells me that he and his Katrinka left their hearts in San Francisco and will move back if ever possible!

Stanley Johnson writes to me from their retirement home in Asheville, N.C. that he and Astrid are coming out here for a few weeks in June and we plan to have dinner at Trader Vic's (best place in town). Two years ago Stan and I went back to Boston for the 50th reunion of our class at Newton High School. . . . **Angie Tremaglio** is pretty well retired, and he and Edith spend the good weather at St. Andrews with much golfing. They are very pleased with their son, Richard, who is an associate professor of architecture at M.I.T. Richard is famous for very special custom houses in the nice parts of the world, and Angelo sometimes helps with engineering advice. . . . As for me, I am pretty well retired except for occasional work on "congenial" projects in heavy engineering construction. I have had a microcomputer (Radio Shack) for seven years and have written all my own programs for estimating critical path, cost monitoring, etc. in basic. The micros will certainly change the world of engineering education."

My thanks to you, Dick, for your newsy letter. I'd love to hear from someone else.—**Alice H. Kimball**, Secretary, P.O. Box 31, West Hartland, CT 06091

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Dick Young, Newport, R.I. was retired as of January 1980 from Arthur D. Little, Inc. as vice-president. Dick's hobbies are water-color painting, long-case clock making (all from solid rough walnut), golf, computer applications (he is on second generation IBM equipment). He is also active on the Trinity Church Missions Council. Dick writes: "just returned from 'The Love Boat' cruise of the Carribean, now planning Canadian Rockies, railbus tour; and Nova Scotia golf scenic trip with friends. Will be at Tides Inn, Va. for 2 weeks reunion of Cleveland friends (all M.I.T. guys!)." His wife Marge's interests are gardening, church and socializing. Dick tells us the 50th reunion plans are moving along and that he and Phil will be visiting the tentative site on the Cape the end of May and will be able to report more positively after that.

Edward C. Peterson of 319 Douglass Dr., Douglassville, Pa. 19518, is semi-retired as president of Rolling Mills Engineers, Inc. Ed operates a cattle farm and butcher shop and is converting old houses and barns on his farm into apartments. He has published 11 papers in *Iron and Steel Engi-*

A bit of reunion time nostalgia. From the year 1935: Allan Q. Mowatt, '35, serves lunch to Alice H. Kimball, '36 (left) and Frances Blackwood Tyler, '37, on the lawn of Walker Memorial.

neer and translated *Mills for Rolling Bars & Shops*, from German. His wife Ruth's interests are tennis, piano, and secretary-treasurer for all operations. For hobbies he plays the violin and plays tennis year round when snow is off the tennis court in his back yard.

Dr. **Bernard Ross,** 230 Entrada Ave., Port St. Lucie, Fla. 33452, has a book *The Fundamental Pathway to Health—A Case for Individualized Replacement Therapy* being published in June. Bernie, accompanied by his wife Irene, will be on a series of promotional tours in ten cities around the U.S. Both he and Irene are well.

Charles P. Cardani, 27 Savoy Rd., So. Hamilton, Mass. 01982, writes "I recently received a very nice letter from our classmate **Chester K. Nie**. We haven't seen or heard from each other since graduation in 1937. Chester stayed for an additional year for a master's degree and then returned to Shanghai where he has devoted his career to electrical engineering, transmission and distribution. Chester and his wife hope to visit the U.S. this fall. My wife and I are looking forward to a reunion."—**Lester M. Klashman,** Assistant Secretary, 289 Elm St., Apt. 71, Medford, Mass. 02155; **Robert H. Thorson,** Secretary, 506 Riverside Ave., Medford, Mass. 02155

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Your faithful secretary Lou
Along with lovely Sandy, too
Has gone to Britain via Rhine
And left the class notes work all mine.
The acting secretary's job
Is too important for a slob
Like me, but I will do my best
To give our faithful Lou a rest
A dual role I fill this day
The second one for Prexy Gray,
To tell you that the Institute
Would love to have you share the fruit
Of all your work since '38
So that we can celebrate
With sense of a tremendous lift
Our 50th reunion gift.
As you divide with us your chips.
The proceeds go to scholarships
For future students who cannot
Without them come here to be taught
The only trouble is—so far
We haven't quite come up to par.
So think about it, give some more,
Then multiply by three or four
And make the gift of '38
The greatest gift of all the great.

In other news **Ed Taft** has retired from Massachusetts General Hospital and the Harvard Medical School faculty and is now living in Stockbridge, Mass. and wintering in Puerto Rico. We also regret to announce the deaths of **Alfred Louie** in Hong Kong and **Paul Branning** in Rio de Janeiro.—**G. Edwin Hadley,** Assistant Secretary, 50 Spofford Rd., Boxford, MA 01921

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Charles Edwards writes that after 30 years with Bendix Corp. he retired in October 1982. Final transfer was from Grand Junction, Colo. to Sunnyvale, Calif. Shortly thereafter he and wife, D.J., moved to 703 Belvedere Way, Santa Rosa, CA 95404. They are now spending part time operating Wine Machinery Enterprises, which services small wineries. Just recently they obtained a "use permit" to operate a small winery (5,000 cases), The Merry Vintners, in the family Pine Road property west of Santa Rosa. Merry, one of their daughters and her husband, Bill, will be the principal operators, since both have been involved in managing the Matanzas Creek Winery in Santa Rosa. The Edwards have two sons, two daughters, and five grandchildren, all living in California.

F. Leroy Foster, 1925 Secretary, now retired professor of mining (Course III), provided a letter from one of his former students, **Jim Ellis**, regarding his activities. Spending four years in the army during World War II, Jim returned to the Illinois area and became involved in the aggregate business, that is sand and gravel and crushed stone for all types of construction, also some chemical stone for agricultural purposes, as well as flue-gas desulferization. He is now president of Moline Consumer Co., Moline, Ill., and has approximately 30 active aggregate plants in Iowa, Illinois, and Missouri, plus several ready-mixed concrete operations. He is extremely fortunate to have three sons, who are now active in the business, as well as two daughters, who have recently joined the company. A third daughter is a junior in college. There are also five grandchildren. He hopes to continue working for some time. . . . **Harry Ferullo**, who was also Course III, is now retired and living on Cape Cod, where he attends meetings of the M.I.T. Club of Cape Cod.

Sad news from the Alumni Association Office indicates that **John McMullen** passed away on December 28, 1983 at his home in Jacksonville, Fla. His wife, Nell, wrote that he battled cancer for eight months and finally gave tribute to God. . . . **E. George Pollack** died April 5, 1984 in a Portland, Maine, hospital. His home was in York Harbor. Born in Vienna, Austria, he received his bachelor's, master's and doctorate from M.I.T. He served with the U.S. Navy for 21 years, retiring in 1961 at the rank of commander. Since then he has been associated as a naval architect and consultant with Arthur D. Little, Inc., in Cambridge, Mass. George is survived by his wife, Barbara, a daughter, Antonia, four stepsons, and a granddaughter.

Received an unexpected and most welcome phone call from **Dave Fleming**, who was visiting his mother at her home in Norwood, Mass. Dave retired from Linde Air Products, Division of Union Carbide Corp., in January 1984 after 42 plus years. He and his wife, Elaine, live in Chatham, N.J. They have four children—three girls and one boy. Forgot to ask about grandchildren. How many, Dave?

That's all the news for now. Please write or call.—**Donald R. Erb**, Secretary, 10 Sherbrook Dr., Dover, MA 02030, (617) 785-0540

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Calvin D. MacCracken is a successful inventor and entrepreneur. He has found a way for electric utilities to use idle night capacity instead of building new plants. His book, *A Handbook for Inventors*, (Scribner's) is selling well. . . . **C. William Hargens** is still teaching Acoustics at Drexel University. His work in biomedics has allowed Bill and Mary to travel extensively. He reports that his seven splendid grandchildren make him feel especially fortunate. . . . **George H. Palmer, Jr.** retired last year after 36 years with the American Bureau of Shipping. He helped rebuild the Great Lakes Merchant Fleet for world commerce via the St. Lawrence Seaway.

Charles H. Pappas is still working with his students on the wave aspects of the shuttle imaging radar problem, on Kapitza's theory of ball lightning, and on electromagnetic isoperimetric inequalities. . . . **George W. Clark** retired from GTE Sylvania Lighting Products Group, but he continues to teach and lecture on illumination at M.I.T. and at Northeastern University. He sent a news clipping of the death of **Leslie Corsa**, M.D. on March 2, 1984. Leslie was a scholar and pioneer in population planning. He was working on a study with Dr. Pi Chao Chen to develop a Chinese population management policy at the University of Jilin.

Herbert R. Moody died January 28, 1984 of lung cancer. Herb joined Rohn and Haas in 1941. He became president of Micromedic Systems Inc. of Horsham, Pa., a Rohm and Haas subsidiary, before coming director of hazards. He retired in 1981. Herb was a past president of the M.I.T. Club of Philadelphia, a member of the American

Chemical Society and the American Institute of Chemical Engineers.

He is survived by his wife, Lois Mae Moody, two children, and five grandchildren. His wife in a touching note asks that classmates who remember Herb drop a note.—**Joe Dietzgen,** Box 790, Cotuit, MA 02635

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A memorial service was conducted April 13 in the M.I.T. Chapel for **Edward George Pollack** (Course XIII), who died April 5 in Portland, Me. Ed was born in Vienna, Austria, coming to the U.S. at the age of 4. He earned his B.S. and D.Sc. from the Institute, and also attended the Naval War College at Newport, R.I. He served 21 years in the navy, retiring with the rank of commander, and spent four years in a Japanese prisoner-of-war camp during World War II. After retirement from the navy, Ed worked as a naval architect for Arthur D. Little Co. We extend our sympathy to Ed's wife Barbara and to the others of his family.

Stanford University Press has just published *Competitive Edge*, a collection of papers about the semiconductor industry in the U.S. and Japan. . . . **John G. Linvill** (Course VI) is a co-author of one paper titled "Technological Resources."

It's hard to match the interest and excitement of last year's 40th reunion, but you could try. Send news.—**Bob Rorschach**, Secretary, 2544 S. Norfolk, Tulsa, OK 74114

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Hope your summer was active and busy and that you are looking forward to fall activities. . . . **John A. Cornell** writes that he has completed a multi-client market survey of dental and medical plastics with Princeton Polymer Labs. To his knowledge his own laboratory, Westwood Research, is the only commercial dental development and testing laboratory in the world exclusively in dentals. . . . **Carl Lindemann, Jr.** sends a note together with a press release and newspaper clippings of his recent retirement as vice-president and assistant to the president, CBS Sports. Carl joined NBC as a student engineer in 1948 and rose to vice-president, Sports. He left there to go to CBS in 1978. Carl, who lives with his wife Marguerite in South Freeport, Maine, is renowned for his work in obtaining major sports events for network television. His efforts filled the wants of the growing audience in spectator sports. Although he was only partially responsible for cutting off the famous New York Jets-Oakland Raiders game for the children's classic *Heidi*, he expects to be forever the scapegoat for the incident.

Paul Heilman's son, Paul III, a graduate of Georgia Tech and an employee of the Stanford Research Institute, has a company which services laser tubes during the evening hours. . . . Andrea Matthews, the daughter of **Peter Matthews**, was the first prize winner of the 1984 Liederkranz Foundation awards for voice, and participated in the 24th annual scholarship awards concert at the Lincoln Center for the Performing Arts. . . . Janice Kispert, widow of **Malcolm Kispert**, spent several months practicing and giving concerts with a group of hand-bell ringers in Lexington.

Burt Bromfield, **Janice Kispert**, and **Melissa Teixeira** were feted during the 1984 Mexican Fiesta in becoming "Eager Beavers" as a result of having attended four fiestas. . . . **Robert Oppenlander**, vice-chairman of the board and chief financial officer, Delta Air Lines, Inc., and **Edward B. Walker III**, president and chief operating officer, Gulf Oil Corp., were honored this spring at M.I.T. when they were among 42 alumni who received the Institute's Corporate Leadership Award. . . . Professor **Robert L. Halfman**, who is associate dean for Student Assistance Services at M.I.T. has approved an overseas program for those M.I.T. undergraduates wanting some study abroad.

Our expressions of sympathy are sent to the families and friends of **Alfredo Rodiquez Delfino**, who died February 5, 1977; **Horace H. Binney**, who died January 8, 1983; **Mualla I. Sezel**, who died January 19, 1983; and **Richard M. Weedon**, who died February 27, 1984.

The next issue will report the results of the election of class officers for the next five years. In the meantime keep your notes coming to me.—**Melissa Teixeira**, Secretary, 92 Webster Park, West Newton, MA 02165

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Thanks to all those somnambulists out there, I got bagelled out of inputs this month. So I rummaged through the 25th reunion book to find some familiar names which haven't been mentioned previously in this column. They're still on the roster, but more details would be appreciated. If a lot of this material is dated, please forgive this humble scribe, 'cause he's swimmin' around out here in the the dark. Anyhow, here goes:

Shep Arkin was last seen managing Raytheon's Advanced Systems in Bedford, Mass. and was living in Lexington. . . . **Roger Bart,** a chemical engineer who went on to get his Sc.D., was/is directing Union Camp Corp. R&D in Princeton, N.J. and living in Chester. The current database shows a business address in Wayne, N.J. but no details. . . . **Andy Burns** runs his own independent consulting firm in Stamford, Ct. . . . **Morris Chomitz**, a chemical engineer who went on to Drexel for his M.S., was last seen managing projects for Day and Zimmerman in Philadelphia, where he also lives. . . . **Noel Coe**, who later went on for an M.S. in chemical engineering at Southern Connecticut State College, lives now in Westlake, La., and is still probably doing R&D in plastics, apparently for Olin Corp., Lake Charles, La., unless, of course, he's hit an oil jackpot and is happily retired.

Ralph Berman went on to Cornell for his M.B.A. and then made it big in Montreal where he runs First Quebec Corp. . . . **Dave Black** went on to Brown for his M.A. in 1966 and was/is directing R&D for Research Corp. in Manhattan, with last known address in Pelham. . . . **Seymour Collins** was at one time president of Westfab in San Jose, Calif. where he lives. Now he's with Combustion Power Co., Menlo Park, Calif.

And that's the way it is. . . . **Jim Ray**, 2520 S. Ivanhoe Pl., Denver, CO 80222

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Everyone must know by now that **Mary Frances Penney Wagley** is president of the Alumni Association. She is the first woman to hold this position, just as she was the first woman on the Corporation and the first to chair two of the Corporation Visiting Committees. To commit her full time to the job, she has resigned as head of Episcopal Social Ministries of the Episcopal Diocese of Maryland, the job she went to after retiring as headmistress of St. Paul's School for Girls in Baltimore. . . . **Ken Block** has been a director of A. T. Kearney, Inc. for the past year, in addition to his position as chairman and chief executive officer. . . . **Henry Lee**, president of Lee Pharmaceuticals in South El Monte, Calif., has a new book out, "Lee's Guide to Published Computer Programs," a guide to personal computer software.

Kevin Andrew Lynch, internationally known for developing the field of urban design and for his pioneering work in establishing the basic theories of how cities are perceived and organized by those who live in them, died suddenly of a heart attack in April. His career spanned 35 years of seminal research, teaching and practice, largely focused at M.I.T. where he was professor of city planning, emeritus, in the Department of Urban Studies and Planning, which he joined in 1949. His major contribution was the development of urban design, a field in its infancy during the post-war years. More than any other person, he helped formulate roles for those planners and designers interested in improving the form and appearance of cities, and he developed the basic theories of how cities are perceived and organized in residents' minds and of what cities mean to people. He invented the realistic possibility of city design. He authored seven books and several dozen articles on cities and their design. . . . **Edmond Holroyd** died in November, 1983. He was a research chemist at the Eastman Kodak Co. in Rochester at the time of his death. . . . **Edward Cote** retired as director, facilities engineering, General Motors, before his death in December, 1983.

My thanks to all who supported my candidacy for the National Selection Committee. I appreciate the honor of being elected and I know I shall enjoy serving.—**Virginia Grammer**, 62 Sullivan St., Charlestown, MA 02129

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Victor Pomper is president of Satellite Data, Inc. headquartered in Weymouth, Mass. Recently his company purchased TX Engineering, Inc., a Seattle-based manufacturer of satellite earth stations and master antenna television systems. In outlying areas where it will be a long time, if ever, before cable comes in, there is a market for satellite receivers capable of receiving 100 channels from the 15 satellites serving North America. Vic's career started in consumer electronics at H.H. Scott, the pioneer manufacturer of hi-fi and stereo components. Sales peaked at $15 million in 1969 before Japanese competition and H.H. Scott's declining health began to take a toll. After attending an advanced management program, consulting, financial planning, management recruiting, and one ill-fated home building company, Vic was convinced by a friend to return to consumer electronics. The friend believed there was opportunity in satellite television, and he steered Vic to some private investors. Vic realizes he is in a high-risk venture, but there is a potentially large market attracting him to accept the risk.

Milton A. Widelitz is consulting on developing airport projects and is a development advisor to institutions on large projects—hi-rise, computer building, etc. . . . **Reginald B. Stoops** is working independently as a consultant on structural plastics but he has moved "back home" to Newport, R.I. to do it. Since last reporting in, he has done another Trans-Atlantic cruise with William F. Buckley, Jr. which he wrote about in *Atlantic High*. Reginald had a busy summer with the America's Cup Races and is looking forward to a Trans-Pacific sail next year. . . . **Bascom W. Birmingham** received an honorary doctor of science degree from University of Colorado in May 1983. He retired as director of National Bureau of Standards Boulder Labs in August 1983. He is now doing consulting in cryogenics and metrology management as "Birmingham Associates."

Lewis A. Blodgett, Jr. is working as a technical advisor at the National Climatic Data Center in Asheville, N.C. . . . **Vaughn L. Beals, Jr.** is chairman/CEO of Harley-Davidson Motor Co. based in Milwaukee. Vaughn and 12 other officers purchased the company from AMF, Inc. in 1981. . . . **Carl L. Kolbe** has retired from the General Electric Co. after 41 years of service. He retired as manager and senior engineer of the Inertia Welding Processes Unit in Evendale, Ohio. Carl still has three of his eight children in colleges. Carl, writes, "Praise the Lord!"

Dave Freedman came out of retirement after eight years to be a volunteer consultant for the International Executive Service Corps to a small independent bakery in Alexandria, Egypt. Dave and his wife, Beverly, had a most gratifying 3-month experience with excellent results. It was memorable. Dave was looking forward to returning to Cambridge to take part in the Alumni Fund telethon. He has been first in his group for four

consecutive years and hopes to extend this for a fifth year. . . . **Roland Nagy** has been elected president of Foster Wheeler Synfuels Corp. The subsidiary concentrates Foster Wheeler's synfuels capabilities into a single organization specializing in coal gasification and liquefaction, methanol-from-coal or biomass, shale oil, tar sands, fuel alcohol and geothermal projects. Before becoming president, Roland was vice-president of commercial operations.—**Marty Billett**, Secretary, 16 Greenwood Ave., Barrington, R.I. 02806

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Stan Margolin in February's *Chemtech*, authored "Why Use Outside R&D?" He makes some strong points for outside R&D, and presents good incentives for selecting A.D. Little, Inc. Stan is a good salesman—and he represents a good company, with innumerable M.I.T.'ers and several '49ers (three very active ones: Stan, **Harry Lambe,** and **Frank Hulswit**). . . . Sorry to report the loss of **Guy F. Boucher** last year. . . . **Fred Brown** couldn't make our 35th reunion. He had previous plans to go offshore fishing—in true Arkansas grandeur. Fred sent a copy of ARCO Steel's 75th anniversary publication. He is president of this Little Rock company.

I hope you had a good summer. As I write this, it's just the start—in fact, we leave in two weeks for our 35th runion in Cambridge and Bermuda. I have enjoyed being your secretary for the past five years. I hope you enjoyed what I wrote. I sure liked hearing from you.—**Paul E. Weamer,** Secretary, 331 Ridge Meadow Dr., Chesterfield, MO 63017

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H. Thomas Wilson is active as an architect and consultant in the southern California area—current joint venture involvement in master planning for the Jet Propulsion Laboratory and projects for the U.S. Navy, in addition to industrial and commercial architecture. He has enjoyed recent travels with his wife, Rene, to Africa, India (where he spent his pre-M.I.T. days), and France. . . . In March, Donohue, Engineers and Architects, named **John M. Hetherington** as a new associate to its corporate organization. John is president of Donohue and Associates, a Chicago area architectural subsidiary based in Itasca, Ill. John became president of Donohue, Hetherington in 1982. Before joining Donohue, he served as vice-president and then president of the architectural firm Fugard, Orth and Associates, with offices in Chicago and Hinsdale. John specializes in educational facility design and renovation, and was recently elected to his second term as president of the Northeast Illinois Chapter of the American Institute of Architects.

It is with regret that we announce the death of **Herbert Levick,** of Wilton, Conn., who died on March 8, in his sleep. He had returned home the day before from a two-week hospital stay for heart surgery. Death was attributed to cardiac arrest. Mr. Levick was director of electronics engineering at Standard Motor Products in Long Island City, N.Y. He devised and taught a weekend course in electronics for the area's gifted children. During his career, he was personally responsible for the design and development of almost 200 products in the fields of communications, avionics, computer terminals, and automotive electronics. He leaves his wife, Shirley, two sons, and a daughter.—**John T. McKenna,** Secretary, 9 Hawthorne Pl., 10-H, Boston, MA 02114

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Now that September is almost here, many of you will especially sympathize with feelings of **Eugene Rapperport** when he writes, "Last tuition bill for third kid paid. Lucy and I can start to live again." He earns the income to pay for tuition and living by doing legal case engineering consulting, comprising accident reconstruction and product liability.

Some of us may well be paying tuition to **John Fitch** on our own behalf. Extending his career in continuing education for engineers, John has become vice-president of National Technological University (NTU), a not-for-profit organization aimed at providing education for working engineers via satellite. While NTU will offer master's degree programs, John will direct the non-credit courses. He is also executive director of a sponsor of NTU, the Association of Media-based Continuing Education for Engineers, Inc. NTU will be based in Fort Collins, Colo., and is scheduled to start operations this month.

I can see the need for this sort of thing in my own career. When I left M.I.T., I did not really understand vacuum tube circuits, for example. From there I went on to not understanding transistor circuits. The march of progress has been relentless, and now I find myself ignorant about digital design, computer science, semiconductor technology, biotechnology, as well as older fields like chemistry and mechanical engineering with which I am involved. I feel fortunate to have been able to keep up.

Reminding us not to be too concerned with tuition and learning, we have the belated news of the death of **Duncan C. Bryan** of Northfield, Vt., who died October 3, 1980. I am sorry I have no other information about him except that he is survived by his wife Patricia.—**Richard F. Lacey,** Secretary, 2340 Cowper St., Palo Alto, CA 94301

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Maurice P. Gionfriddo "Moe" informs us that he was general chairman of the American Institute of Aeronautics and Astronautics' Eighth Aerodynamic Decelerator and Balloon Technology Conference, held in Hyannis, Mass. in early April. Attendees came from all over, including India and Western Europe. Moe is chief of the Airdrop Systems Division at the Army's Natick R&D Center, where he has worked for 27 years.

We've now completed one year in which our 1953 class notes have been in every issue of the *Review*, and the 1984-85 year will continue this unbroken string. Some of the articles will be short, as this one is, because not too much material has been received, but I'll write something, even if it's just to say "Hi" and let you know about Berna's and my first grandson, who has his first tooth at six months. Also, the youngest of our four children just graduated from college.

Please drop us a line if you've recently been married, promoted, elected or appointed to some position; done something you're proud of; have children who recently got married or a new grandchild; or have had some other important event occur that you would like to share with old friends. Remember, I'd like to include something about every one of you in our column before our 35th reunion in 1988.—**Wolf Haberman**, Secretary, 41 Crestwood Dr., Framingham, MA 01701; **Joseph M. Cahn**, Assistant Secretary, 289 Bronwood Ave., Los Angeles, CA 90049

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This is being written in the midst of the Massachusetts monsoon season—late May—which coincides with all those outdoor commencement cermonies scheduled by institutions of higher learning. The Massachusetts commencement rain clouds extended as far north as Burlington, Vt., where, two weeks ago, our son John Luigi received his B.S. in business administration from the University of Vermont. But those crafty Vermonters, who occasionally have snow at their commencements, started the outdoor cermonies promptly at 9 a.m., completed them expeditiously, and then withdrew to scattered and safer indoor locations before the rain clouds had a chance to develop into a full-fledged storm.

Samuel Armour is bucking the trend. He has transferred from San Jose, Calif. to Atlanta, Ga. Sam works for G.E. and is starting up an engineering support group for light water nuclear plants in the southeast. . . . **Herbert Slater** has moved up from vice-chairman to chairman of Slater Electric, Inc. of Glen Cove, N.Y.

I am saddened to have to report the sudden death of **Helmut J. Maier**. Jack, who attended our 25th reunion, was a fellow chemical engineer. We shared many memories from our Institute days. Our condolences go to his wife Bea and their daughters, Debbie and Sharon.—**William Combs**, 120 W. Newton St., Boston, MA 02118; **John Kiley**, 7 Kensington Rd., Woburn, MA 01801; **Louis Mahoney**, 52 Symor Dr., Convent Station, NJ 07961; **Dominick A. Sama**, 28 Chestnut Hill Rd., Groton, MA 01450

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E. Thomas Jones has been appointed assistant superintendent, Film Sensitizing Division, Film Manufacturing Organization at Kodak Park in Rochester, N.Y. Tom joined Kodak in 1961, and his most recent position was assistant director, Color Photography Division, Research Laboratories. . . . **Robert R. Pollard** was named president of the Organic Chemicals Division of W.R. Grace and Co. in Nashua, N.H. Pollard joined Grace's Organic Chemicals Division in 1965 and in 1969 was named vice-president of marketing for the Hampshire Chemicals Division and in 1972 assumed responsibility for all marketing activities of the Organic Chemicals Division. In 1981 he became executive vice-president of that division. . . . **James A. Dugelby** is currently involved with interior modifications to corporate aircraft, including the Boeing 747.

A. J. Viterbi

Andrew J. Viterbi, is the recipient of the prestigious Alexander Graham Bell Medal for 1984, for his exceptional contributions to the advancement of telecommunications. The award was presented in Boston in conjunction with the ELECTRO Convention on May 13, 1984, a date which commemorates the centennial of the founding of the Institute of Electrical and Electronic Engineers, and the beginning of the electrical engineering profession. The IEEE has an international membership of nearly a quarter-million electrical, electronic, and computer engineers. Prior to winning the Alexander Graham Bell Medal, Viterbi won three paper awards from IEEE and other professional societies between 1962 and 1968, the Christopher Columbus International Award from the Italian National Research Council in 1975, and in 1980 was joint recipient of the American Institute of Aeronautical and Astronautics Aerospace Communications Award. Before becoming president of M/A-COM LINKABIT in 1982, Viterbi was its executive vice-president since 1968, when he and Dr. Irwin M. Jacobs co-founded the company. From 1963 to 1973 Viterbi was professor of engineering and applied science at the University of California, Los Angeles, and since 1975 has been an adjunct professor of engineering and applied science at the University of California, San Diego.

Computers for scientists and engineers—that's what Bill Poduska, '59, (left) makes. As founder of Apollo Computer in Chelmsford, Mass., he projects the company to reach $1 billion a year in sales by 1988, after only eight years in business.

In four years, the company has grown from a hand-written business plan to an operation with 1,400 employees, with sales expected to reach $200 million by the end of 1984.

Apollo's computers are capable of running two programs at the same time while the user is writing a letter or designing electronic circuitry. A number of "windows" appear on the screen, and each window can perform a different task. (Photo: Jodie Andruskevich, **Lowell Sun***)*

The prestigious positions which Viterbi has held are many: member of the National Academy of Engineering since 1978, Fellow of the IEEE since 1973, and member of the Visiting Committee for Electrical Engineering Departments of Technion, Israel Institute of Technology, and of M.I.T. He has also been distinguished lecturer at the University of Illinois Coordinated Science Laboratory.—Co-secretaries: **Robert Kaiser**, 12 Glengarry, Winchester, MA 01890, (617) 729-5345; **Caroline D. Chihoski**, 2116 W. Davies Ave., Littleton, CO 80120, (303) 794-5818

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Clearly, the nation's business magazines have discovered the Class of '58. By now, you have all probably seen the flurry of articles covering some of our illustrious classmates. An article in *Forbes* (May 21, 1984) titled "Heave Ho" described the "bar-bell" investing approach of **Howard Shawn**, now a money manager at Cowen and Co. He was earlier covered in the business section of *The New York Times*. . . . Several articles have appeared in such publications as *Forbes* and *Venture* regarding the formation of Morgan, Holland Ventures, a venture capital firm. If you haven't already guessed, one of the principal partners is none other than **Dan Holland**, who had previously managed the Boston Office of the First National Bank of Chicago, and earlier had been a vice-president of American Research and Development. Because Dan and I keep meeting on flights to New York, we have been able to talk business over gourmet lunches at the Eastern snack bar. . . . From "Down Under," **Mike Balderston** wrote to tell us that he has been able to attend some of the informal alumni meetings in Sydney and Melbourne with guest-of-honor John Bertrand, '72, skipper of the *Australia II*. As most of you know, Mike and his family moved to Australia several years ago, and he works for Telecom Australia.

David Baldwin was recently appointed deputy associate director of Magnetic Fusion Energy at the Lawrence Livermore National Laboratory. . . . At the Consolidated Natural Gas Co. in Pittsburg, **Leonard Timms** was recently promoted to senior vice-president of operations. He had previously been in operations for a subsidiary of the company, Consolidated Gas Supply Co. . . . **Leonard Simon** has assumed the position of chairman and chief executive officer of the Community Savings Bank in Rochester, N.Y. Earlier, he had been an executive vice-president of the bank. . . . Recently, **William W. Smith** was made vice-president of product engineering at A.O. Smith Harverstore Products. Bill joined A.O. Smith in 1979 as director of product engineering and research, and prior to that had held various positions with pump manufacturers and with aerospace firms.

Well folks, as we enter the fall campaign season, keep those cards and press clippings coming.—**Michael E. Brose**, Secretary, 59 Rutland Square, Boston, MA 02118

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In May, **Bill Hecht** called a group of Boston classmates together to get a head start on the 25th Reunion. The matter at hand was the reunion gift. Class donations for several years before the 25th are combined into a single large gift, the destination of which is in the hands of a gift committee. The committee could give a group of scholarships, faculty development funds, or some physical object (my daughter, Stephanie, suggests a vacuum cleaner). Who will be on the committee and what they will do is still to be determined—your suggestions are hereby solicited. I'll keep my ear on their discussions and report on their conclusions. Our classmate **John Sununu** is governor of New Hampshire. He is respected as an able administrator, but is controversial on some policy issues. John is a strong supporter of the Seabrook Nuclear Power plant, which has been a focus of anti-nuclear activists over the last decade. Recently, Seabrook has been running into financial difficulties, and John has been very active in trying to resolve these problems. Last November, Governor Sununu gave the Roy V. Wright Lecture at the national A.S.M.E. convention in Boston. He called for more involvement by engineers in the political process. "The key to good public policy is the quality of technical . . . inputs," he said. "I do not want to die an old politician, I want to die an old engineer."

John Baxter writes that he and **Harry Baya** are co-chairs of the Apple special interest group within *USUS*, the U.C.S.D. Pascal User's Society. Joe Larkin, '46, was elected secretary, completing the M.I.T. "capture" of the group. . . . **Garry Gustafson** has changed jobs at United Technologies. He now is manager of management information services within the Turbo Power and Marine Systems, Inc., section. He says, "After 14 years I still enjoy Florida and expect to see more of my classmates when they begin to retire in another 10 years." . . . **Fred Schmidt** reads these notes and enjoys hearing about all our successes. He says, "My job of battling the yearly budget for bullets, bombs and rockets for the Navy is much more mundane. My frequent travel has enabled me to keep in touch with **Don Fowles**, in Iowa City, Iowa, **Terry Scharton** in Santa Monica, Calif., and **Harry Baya**."

M.I.T. Press has published in paperback **Dick Meehan**'s wonderful book, "Getting Sued and Other Tales of the Engineering Life," about his life as an engineer. The reviews have been good. . . . **Harold Bowers**, my old Course VIII lab-mate, is now technical director of the Hughes Aircraft Co. Industrial Electronics Group. Hal has been at Hughes for 15 years and has published more than 40 papers on all sorts of microwave devices, circuits and systems. . . . **Jorge Hernandez-Figueroa** is sales manager for ROLM Corp. in the Latin American/Caribbean region. Rolm is in the telecommunications systems business. This work

Anticipating its gala 60th reunion, the Class of 1924 early in June inducted William J. Hecht, '61, executive vice-president of the Alumni Association, into its ranks as an honorary member. Here Hecht receives his red coat from Donald E. Moore, president of the class.

keeps him traveling around his region quite frequently, and he would like to contact alumni in the area. You can get in touch with him through ROLM in Santa Clara, Calif.

An article in the *Boston Globe* a couple of months ago complained about the fact that fitted sheets don't fit mattresses. **Al Klancnik**, vice-president for manufacturing services at Sealy, says the extra padding on modern mattresses is the cause of this problem. The mattress is more comfortable because of the extra couple of inches, but no one seems to have told the sheet manufacturers. Al solves the crisis by safety-pinning his sheets to the mattress. Meanwhile, the sheet manufacturers blame the mattress manufacturers. Standards need to be reset.—**Andrew Braun**, Secretary, 464 Heath St. Chestnut Hill, MA 02167

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Things have been quiet at the Class of 1962 newsdesk. The small amount that follows is the sum of two months' news. **Albert Blackwell** is author of a book published by Harvard Theological Studies, titled *Schleiermacher's Early Philosophy of Life: Determinism, Freedom, and Phantasy.*" . . . **Joseph Bloomer** is currently professor of medicine, University of Minnesota, and director of the Division of Gastroenterology and Hepatology. He has recently served on the Scientific Advisory Board of the American Liver Foundation and American Porphyria Foundation and has been chairman of the research committee of the American Liver Association. . . . **C.W. "Woody" White** is serving this year as president of the International Materials Research Society. He is co-leader of the ion-solid interactions group in the Solid State Division of Oak Ridge National Laboratory, where he has worked since 1975.—**John Prussing**, Secretary, 2106 Grange Dr., Urbana, IL 61801

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Why do we work? Silly question. Few of us have made enough yet to retire. And even those who have need of a challenge—for example, how to make the next million or hundred million. To make a living is obviously not enough. If it were, we would have become plumbers, electricians, truck drivers. We went to the 'Tute to get means to ends: We wanted a way to make money but also beat our heads against intellectual barriers, sell more widgets than anyone else, acquire more outlets for our lusts for power. So, now we're all achieving. And what do we crave? The time to read a good book, relax on a Caribbean island, play ball with our children (soon, our grandchildren), make leisurely love. And the patience. We secretly covet the moments away from serious work, when we must "waste" time making photocopies, sorting papers, cutting articles out of professional magazines, and otherwise retreating into kindergarten. Perhaps these ruminations come from reading a letter I got recently from William Jouris, '61, who lives in Riyadh, Saudi Arabia. He adds to my earlier report on the death of **"Chip" Goldberg**: "Chip was one of my best friends and a fraternity brother in Delta Upsilon. At the time of his death from liver cancer, Chip was a senior consultant with Butler Cox and Partners, Ltd., of London, and shortly was to have become a partner. He is survived by a lovely wife of two years marriage, Cherry, and a daughter, his first child, born two weeks before his death. He will be sorely missed by his friends, relatives, and classmates." Condolences and thanks to Mr. Jouris. **Philip Schneider** is in the research department of Solar Turbines, Inc., and lives in San Diego, Calif. . . . **Michael Lukas** is manager of contract research at Bailey Controls. "It's an interesting challenge, matching up outside funding with internal plans to expand product applications and new product development." . . . Another corporate mover is **Steve Kaufman**, now executive vice-president and board member at Arrow Electronics. Steve lives in Huntington, N.Y. . . . **Steve Ditmeyer** and his wife Marty announce with pleasure the birth of their son, David Stark, who will be about fifteen months old as you read this. He and older sister Anne (3) keep Steve and Marty on their toes.

And so, having achieved all I suppose I'll achieve, I while away the hours cleverly cajoling my classmates to communicate.—**Phil Marcus**, Secretary, 2617 Guilford Ave., Baltimore, MD 21218

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Barry Wessler writes that it has been almost two years since he left G.T.E. Telenet to start NetExpress, and his new company is nearing the beginning of its service offering. Barry says that for him the formation and growth of a new entity is the most exciting part. Speaking of which, Barry's children, Michael (14) and Emily (10) are following in Marilyn's footsteps by winning prizes in Washington-area art contests and violin competitions—and, following Barry, science fairs. . . . **Phil Hardin** writes that he is now president of LYNX Corp., a management consulting firm in Bellevue, Wash., that assists companies in using computer systems effectively. Phil has also been elected chairman of INTEREX, the international association of Hewlett-Packard computer users. Phil reports that INTEREX has about 8,000 worldwide members, publishes three magazines, provides software libraries, and holds four major conferences each year.

Charles Seniawski, an Air Force lieutenant colonel, writes that he left the Big Sky of Montana on April 3 to go to Vandenberg A.F.B., Calif., where he is chief of maintenance for the 394 I.C.B.M. Test Maintenance Squadron. . . . **Jim Young** writes that he is research professor of electrical engineering (but doesn't specify the school), specializing in lasers and optics—thanks to his early work with and inspiration by "Doc" Edgerton. Jim's present goals are the development of very short wavelength lasers in the 10 to 100 mm range. His hobbies are keeping two vintage Porsches running by making full use of modern technology (50% successful), plus gardening and cooking. . . . **George Hadley** writes that he has started playing soccer in the over-30 league. He says that he may confess his age, as the 30-year-old kids run too fast.

John Rosenthal has been promoted to full professor of mathematics at Ithaca College in Ithaca, N.Y. John came to Ithaca from S.U.N.Y. Stony Brook in 1971. He was named a Dana fellow in 1981 in recognition of excellent teaching and research, and significant contributions to the College. . . . **Jim Hester** is now assistant professor in the College of Health Professions at the University of Lowell, Mass. Jim will be principal investigator for a grant to the University from the Robert Wood Johnson Foundation to evaluate the effectiveness of preferred provider organizations in containing health care costs.

Nine months more till the Reunion. Anyone out there who wants to take over for the next five years? If so, drop a note.—**Steve Lipner**, Secretary, 6 Midland Rd., Wellesley, MA 02181

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Our class president, **Stu Vidockler**, has been appointed budget director for the city of Boston. Our congratulations go to Stu on his selection by Mayor Flynn. . . . **Norman Fainstein** has been appointed dean for academic affairs in the Graduate School of Mangement and Urban Professions at The New School of Social Research in New York City. . . . **Harold Porosoff** has been appointed director of American Cyanamid Co.'s Consumer Products Research Division.

Congratulations to **Dennis Sivers** on his marriage to Anne Olson in June 1984. Dennis is doing research in theoretical particle physics at the Argonne Labs and enjoys spending time sailing on Lake Michigan. . . . **Martin Kaliski** is director of computer engineering at Northeastern University. The Kaliski's have three children: Aliza (4), Rafael (2), and Natalia (1).

Jeffrey Kenton has founded XYVISION, Inc. The Kentons live in Wellesley and have a two-

year-old daughter. . . . **Alan Dinner** has been named director of product development by Eli Lily and Co. . . . **Robert Poole,** president of the Reason Foundation in Santa Barbara, sent me a letter describing his work. His foundation has been recognized for its work on the movement of government functions into the private sector of the economy. . . . **John Dawson** recently completed a two-year study on the life and works of Kurt Godel at the Institute for Advance Study at Princeton. He will be returning to Penn State/York where he is associate professor of mathematics.

Please send any class news you have to **Joe Shaffery**, Secretary, 34 Hastings Dr., Ft. Salonga, NY 11768

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Jim Small has left university life to become physics division leader with the Tetra Corp., an R&D firm in Albuquerque, N.M. Jim and Gloria are also pleased to announce the arrival of identical twins, David and Jonathan, each weighing 21 pounds at 16 months, by adoption from the state of New Mexico. Jim was in Boston in April and spent some time at the Institute. During his visit he bought some M.I.T. jogging suits in matching toddler and adult sizes. He says, "What a lifestyle change after all these years without children." . . . There was a production of **Richard Zvonar**'s intermedia theater piece, *Soul Murder*, at Berkeley Stage Co. in September 1983. Also, Richard produced an album by Diamanda Galas for Metalanguage Records, with recent performances with Galas in New York, Washington, D.C., Minneapolis, Chicago, Santa Barbara, and Los Angeles. When Richard wrote, additional performances were scheduled for Boston, Lincoln Center in New York City, and at Holland Festival.

Last January, **David Schramm** climbed Aconcagua in Argentina, which at 7,000 meters is the highest mountain outside of central Asia. Also in January he received the 1984 Richtmeyer Award of the American Association of Physics Teachers. Dave is currently the Louis Block Professor of the Physical Sciences at the University of Chicago and is completing his second term as chairman of the Department of Astronomy and Astrophysics. . . . **Yupo Chan** relocated to Washington State University in the summer of 1983. He is associate professor in the Department of Civil and Environmental Engineering. . . . **Bill Lange**, as general manager, System Control Pan American World Airways, is in charge of Pan Am's 24-hour-a-day systemwide operations control functions.—**Jim Swanson**, 878 Hoffman Terr., Los Altos, CA 94022

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Robert Dennis of Framingham, Mass. is now president of the Municipal Bond and Municipal Fund Department at Massachusetts Financial Services. He and his wife recently announced the arrival of their second daughter, Rachelle. . . . **Guillermo Vicens** has been named vice-president of Camp Dresser and McKee, Inc., a firm specializing in environmental consulting. He manages the firm's new business efforts in the federal sector and the water resources group in the northeast. . . . **Wesley Moore** and his wife are expecting a second child in September. . . . **John A. Friel** is senior vice-president and manager of Securities Corp. of Donaldson, Lufkin and Jenrettee in New York. He formerly was with Mabon Nugent and Co.

Received a note from one of our classmates who indicates that **Ed Chalfie** had a recent addition to the family, a baby girl, and that **Phil Byer** stopped by for a visit after being in England for his first sabbatical. He is a professor of civil engineering at the University of Toronto.

Alejandro Chu is a member of the technical staff at M.I.T.'s Lincoln Laboratory. He recently published a paper concerning milimeter-wave components.

Robert Scalan continues to direct the M.I.T. Drama Program. He was married in June 1983. . . . **Stephen Cooper** had a busy year (1983). He got married and acquired three kids and a dog. . . . **John R. Holding** was named vice-president of Strategic Planning and Business Development at Heller International Corp. The company involves asset-based lending, equipment leasing, factoring, and other financial services. Previous to that he was vice-president of market development for the Chicago Board of Trade.—**Robert O. Vegeler**, Secretary, Dumas, Backs, Salin and Vegeler, 2120 Fort Wayne National Bank Bldg., Ft. Wayne, IN 46802

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Del Knarr is enjoying life in California. He is with T.R.W. and speaks very highly of his coworkers and supervisors. . . . **DuBose Montgomery** is a managing general partner of Menlo Ventures, a venture capital partnership which has over $120 million in capital, with investors in the U.S., Canada, France, Switzerland, and the United Kingdom. . . . **Peter G.H. Hwang** writes, "In January, 1984, I completed five years of marketing for I.B.M., most recently as a part of the engineering/scientific and CAD/CAM sales organization. I had an excellent experience and became a more polished human being through I.B.M. sales training. I have opted for product marketing management experience in a computer-aided engineering venture funded by IMPELL Corp. I am product administrator for a workstation to be introduced in 1985. While doing some marketing research in Columbus, Ohio, I tried to locate **Bill Hunt**. I found out he is in Carnervan, Ontario, working as an independent software consultant in decision support systems, having spent a few years teaching computer science at Carnegie-Mellon. In my capacity at IMPELL I decided to hire another consultant that was a bit closer. Only after he had flown down from Canby, Ore., and shaken my hand, crushing it with an enormous Brass Rat, did I remember that **Randy Prakken** and I were freshmen together in Baker House and classmates in many Course VI core courses. Randy was formerly vice-president at COMSAT General Integrated Systems and is now a principal of Productivity Unlimited, systems consultants in CAD/CAM and communications systems. Now that I am working in San Francisco and commuting, and with my wife expecting in October, I see the merits of living farther north. We have bought a house in Burlingame, Calif."

Dwight A. Davis joined Lockheed Advanced Marine Systems as an operations planner. His coed softball team has won the Lockeed A. League championship for two consecutive years. . . . **Daniel Backman** is a finalist for the General Electric Aircraft Engine Business Group's William Badger Award. He was noted for developing material processing that led to the introduction of the cost-reduced A-286 compressor impeller for the General Electric CT7 engine. He has been with the Aircraft Engine Business Group for five years. He and his wife, Susan, have two children.

Although it won't be for awhile, let's all make plans to attend our 15th Reunion. I would like to receive ideas about how to increase the attendance and what activities you would like.—**Hal Moorman,** P.O. Box 1808, Brenham, TX 77833

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Douglas Mahone and Lisa Heschong, '78, had their second child, Tyler, on February 10. Doug is an associate with Vaderryn, Calthorpe, Matthews in Sausalito, and Lisa is teaching architecture at Berkeley. . . . **David Wortman** is senior research engineer at the Solar Energy Research Institute and is "into running, skiing, gardening, camping, and enjoying the Colorado sunshine." . . . **Robert Cohen** is deputy treasurer at Louis Dreyfus Corp., responsible for financial and currency hedging. He has two sons, David (2) and Matthew (born March 13). . . . **David Leiner** is business development organization manager at G.T.E. Government Systems in Mountain View, Calif., and recently received a Leslie Warner Technical Achievement Award for work on a system for collecting and processing radio signals. . . . **George Flint** is an attorney in general civil practice in Dallas.

Joe Clift writes that he is "director of planning for the Long Island Railroad; have received a quick education in Long Island and New York State politics and the art of getting businesslike decisions made in a minefield of special interest groups." . . . **Richard Nelson** is "still active as an elder in the local congregation of Jehovah's Witnesses and also still at Pratt and Whitney Aircraft (Commercial Engineering) as senior analytical engineer." . . . **Daniel R. Lynch** is assistant professor of engineering at Dartmouth and received a President's Young Investigator Award from N.S.F. He is working on the application of numerical methods and finite element analysis in a number of fields, including groundwater pollution, oil pipelines in frozen ground, and hyperthermia cancer therapy. . . . **Charles Michal** has opened a partnership, Pietz and Michal Architects, in Keene, N.H. He is currently working on a study of the Jaffrey Mill. . . . **Steven Lerman** has been appointed director of Project Athena at M.I.T. . . . **Don Levinstone** spent a month this winter cruising the Niger River and traveling through West Africa. . . . **John Scalea** is director of market planning information systems for U.S. Air in Washington. He and his wife, Ann Marie, have been involved in compiling and publishing a collection of contemporary hymns with a companion cassette. They have two sons, Mike (5) and Joe (3), and were expecting another child at the time of writing.—**Dick Fletcher,** Secretary, 135 West St., Braintree, MA 02184

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The news is bleak and sparse this month. A mere three letters crossed my desk. Tut-tut, men! . . . **John Wacholtz** is district manager for Oildale Schlumberger Well Services. . . . **Dennis Intravia** is president of Mind's Eye Technology, Ltd. . . . **Tom Wheller** is assistant professor of biochemistry at the University of Louisville. His wife Valerie has given him two sons, Jay and Eric.

Sylvia Weatherford notes that she is diagnostics product manager, for the 8010 Professional Work Station of Xerox in El Segunda, Calif. She also chairs the Western Regional Black Engineering Council.

That sums it up, I guess. Junior is 3, Eric is 10, I'm, uh, 33, and our house is now ten weeks old. I'm still with Surles here, teaching voice, singing with the old barbershop quartet, and life goes on. Write.—**Robert M.O. Sutton, Sr.,** Secretary, "Chapel Hill," 1302 Churchill Ct., Marshall, VA 22115

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We have a wide assortment of news. Please keep it coming. From the mails we learn that **Joel Buckley** is a product manager at Geophysical Survey Systems, Inc., in Hudson, N.H. . . . **Todd Kushner** is currently working at Vicom Systems, Inc., San Jose, Calif., as senior software engineer. . . . **Michael Rucker** is alive and well in Phoenix, Ariz. . . . **Richard Winters** has gone back to his hometown, Poteau, Okla. and is now practicing internal medicine in a six-man group with family practitioners and a surgeon. . . . **Melvin Schorin** is working as an emergency department physician in Falmouth, Mass., and trying to write a science fiction novel. . . . **Jules Morris** states: "Have changed jobs again! Now a patent attorney practicing at Cesari and McKenna in Clinton Way in Boston."

Russell Jacoby will graduate with honors from the New York University School of Medicine in May with the degree of M.D., and begins a residency in internal medicine at Rush-Presbyterian St. Lukes Medical Center in Chicago. . . . **Steven McConnel** has resigned from Georgia Tech, and is now working for Wycliffe Bible Translators at the International Linguistic Center in Dallas, Tex. His job involves the development of computer software to aid linguists and translators.

Tom Hirasuna and **Jean Hunter** wrote me a very newsy letter in late March: "**Doug Denholm** recently moved into the Westchester (N.Y.) area—he works for St. Regis Paper Co. in West Nyack as a chemical engineer in development. . . . We plan to go to **Bernie Tao**'s wedding next month. He's at Iowa State now, working for a doctorate in chemical engineering. He'll be marrying Ann Minnich in Cincinnati on April 7. On the way over we plan to stop in on **Tom Parham** and **Pam Whitman** in Cleveland. Tom completed his chemical engineering doctorate at Cornell in June 1983 while Pam was working at Corning Glass. Now Tom is working at G.E. and Pam is working for her doctorate at Case Western, also in chemical engineering." Tom H. also reports that he finished his M.S. in chemical engineering from Columbia while going part-time. He is still with General Foods in Tarrytown, N.Y. Jean will be finishing her Ph.D. in chemical engineering from Columbia shortly.

And from **Chris Roberts**, "After graduating from Course VI, I went to the University of Virginia for a law degree and practiced in New York City for five years, specializing in antitrust counseling and litigation, with a sideline in space commercialization. I ultimately decided that I would rather be in business for myself than practice law, so I came back to Sloan to get a master's in business. I intend to pursue space commercialization when I leave Sloan next year. The Reagan administration's decision to commercialize space has opened up many opportunities. The other major development in my life is my marriage last summer to Jennifer Dupee, a Bryn Mawr graduate. She too is a lawyer and works for Gaston, Snow and Ely Bartlett in Boston. We are now living in Watertown."

An amusing note from **Skip Carter:** "Well I've finally done it, I got my Ph.D. I can't believe that I am no longer a student, although my paychecks are mildly convincing. My degree, which I received in June 1983 from the Division of Applied Sciences—Harvard's miscellaneous sciences department, reads applied physics. Actually my specialization is in physical oceanography (i.e. ocean physics). Since then I have been working at Harvard as a post-doctorate in oceanography. I expect to stay until the end of the summer of 1984. . . . Most likely, I'll stay in academia and be an oceanographer at some university. In the meantime, I am enjoying being able to spend the time to read a novel and not feel guilty about wasting time."

Frank Ruiz, writes "My work as a senior engineer at Union Carbide R&D in New Jersey has me traveling a lot and working in the exciting UNIPOL area. I wish all the best to my buddies from the Jazz Ensemble—do you hear me out there Leon and Tampy?" . . . From **Richard Kusleika,** "Working at Instrumentation Laboratory in Lexington, Mass. as R&D project manager, on cardiovascular catheters and disposables." . . . And from **James Ryan,** "New job: manager of data processing department at Putnam Furniture Leasing Co. in beautiful Central Square, Cambridge." . . . And Dr. **David Lee** states that he has "finished radiology residency at Mt. Auburn Hospital, Cambridge, and is moving to New York City for a fellowship in medical imaging in July."

Alex Oliver is still living in Wellesley, with his wife of six years. He's working for Wallace, Floyd Associates, Architects, in Boston where he has been since last October. He says, "I still pine for San Francisco even after a month's visit last year. Maybe Paris this summer will help." . . . **Martin Deneroff** writes, "On November 28, 1982 I married Janet Lee Dauber. We recently purchased a home in Livingston, N.J. I am presently working for Auragen Systems Corp., in Fort Lee, N.J., designing fault tolerant computers."

Robert and **Judy (Leider) Lambe** have sent word that they now have a second child, Jennifer Lynn, born December 27, 1983. Her older brother, Andrew Thomas was 2 on January 9. Congrats. . . . Your secretary and his wife had the pleasure of attending the bris (ritual circumcision) of Michael Simon Dershowitz, son of **Dan Dershowitz** and Debbi Gross, '78. Dan and Debbi were at my wedding, along with **Gary Buschwald, Erland van Lidth de Jeude, Ricky Farber,** Cheryl Allen, '78, Linda Roux, '78, and Sharon (Gill, '78) Chandler. . . . Also your secretary bumped into Dr. **Dominick Zito** at the reception for the new chairman of the M.I.T. Corporation at the Museum of Natural History. At the gala, we were the only '76ers we could find. We adjourned for dinner, and I learned that Dominick is now married to someone he met while finishing medical school in Catagnia, Italy. He is now doing a residency in New York City. His wife, who is also a doctor, will be joining him shortly.

While in Hawaii, your secretary, while on a sailing/snorkeling cruise, met Mr. and Mrs. Chet Steinberg, '67, who were also vacationing. They saw my brass rat and asked. Also, I met up with my old 5.32 instructor, Gilbert Lee, Ph.D.'77, and his wife Jennifer. How and why is a bit too long for this issue of the notes, but it was a very pleasant surprise.

Trading notes: As of this writing, your secretary is checking out the opportunities in selling pencils in the Bowery! Seriously, the strengthening of the U.S. dollar to ten-year-ago levels in the Swiss franc and the crash of the bond market hurt, and hurt badly. After these two successive baths in Hudson River water (versus the alternative, champagne), I am withdrawing from trading so as to recuperate and take a fresh view. We live in volatile, financially perilous times.—**Arthur J. Carp,** Secretary, 211 W 79th St., Apt 5, New York, NY 10024, (212) 362-2450

77

Joan Hughson and Roger Renshaw, '79, planned to be married in May in Wakefield, Mass. Roger and Joan both work at Douglas Aircraft Co. in Long Beach, Calif., and hope to see alumni who came for the Olympics. . . . **David Outzs** has recently joined Hewlett-Packard as a systems engineer, and will be doing software support on their technical computers and training on advanced operating systems. . . . **Steve Mel Aaronson** is working in southern California on performance analysis and modeling and has developed a graphics system. Steven has his own computer consulting business as an aside, and is interested in hearing new ideas for implementation. . . . **Gary Porfert** recently became chief of the Installation Assessment Branch of USATHAMA. Gary is responsible for the army's effort to look at all its property and identify any contamination problems.

Julian West is working at Ztel developing a voice and data PBX. Julian says, "My first child, Andy, is loads of fun now at 18 months." Number two is due in June. . . . **Steven B. Oblath** and his wife had their first daughter in January. Steven is still living in Aiken and working for Dupont with several groups of researchers at Georgia Tech. Steven says, "They are not at all like the way I remember at M.I.T."

I am now taking up golf, along with my husband, Mark '76, and thoroughly enjoying the Colorado sunshine. From my window here at work, I can see the Air Force Thunderbirds practicing near Pikes Peak for tomorrow's Academy commencement. It's a tough life. Please do write, and include some details; as you can see, we've got plenty of room in the column lately.—**Barbara Wilson Crane,** Secretary, 6431 Galway Dr., Colorado Springs, CO 80907

79

Norm Guivens dropped me a postcard from London. Norm and Curt Fennell, '78, were "lounging around our stateroom aboard *U.S.S. Sanpan* (LHA-2)." Norm is a lieutenant with the Navy, currently deployed with the Second Marines on special assignment. Norm writes, "After maneuvers in the Troms area of Norway, we visited Portsmouth, England, and Zeebrugge, Belgium, with side tours to such places as London and Amsterdam. Curt also went to Paris." . . . **Tom Potter** married Sandy McCarley, '80, in September, 1983, in Big Moose, N.Y. Writes Tom, "It was a fun weekend with many friends from the 'Tute. We ate, drank, played softball and Frisbee, and were able to sneak in a ceremony to boot!" Tom and Sandy have both joined the Peace Corps and are working as civil engineers in the Republic of Seychelles. "Sandy will be supervising the construction of a drainage system for the capital city of Victoria. I will be working as a traffic and tranportation engineer building roads and riding buses. The country is a beautiful island paradise way out in the Indian Ocean. Another volunteer here is **John Thayer,** who has been here for six months with his wife, Ann, a Wellesley graduate. John works on the diesel-generating equipment which supplies the islands with electricity. Our house has plenty of room for guests, and we offer an open invitation to anyone wearing a Rat!"

Suzane Burzyk chairs the Boston section of the American Society of Mechanical Engineers (A.S.M.E.), a chapter of more than 2,500 members. Suzanne reports, "This year, A.S.M.E.'s Winter Annual Meeting was held in Boston, with over 2,000 engineers from all over the country attending. As head of the section hosting the meeting, I was in charge of committees responsible for raising funds for student events, sponsoring local industry tours, organizing family activities, etc." Suzanne is with Polaroid Corp. in Waltham. . . . **Robert Dezmelyk** started a business three years ago, and Laboratory Computer Systems of Cambridge is now an "acknowledged national presence in the imaging technology market," according to a publication called *Mass. High Tech.* Dezmelyk recently addressed a group of M.I.T. undergrads interested in learning what it takes to start a successful business. The seminar was part of a series sponsored by the M.I.T. Enterprise Forum. . . . **Tom Tantrai** works in Pennington, N.J., at Mobil's Northeast Computer Center, where I have run into him a few times.—**Sharon Lowenheim,** Secretary, 131 E. 83 St., Apt. 2G, New York, NY

80

Has it really been five years? Well, almost. Our 5th reunion will take place early next June, so mark your calendar now and stay tuned.

Dean Phillips and his brother John (famous for designing an atomic bomb while at Princeton), principals of Aristotle Industries, are sweeping the marketplace with "Campaign Manager," a software package that coordinates data management and cross-reference capacities of an I.B.M. P.C. for political purposes. The package stores as many as 75,000 detailed profiles of voters, including standard demographics and views on a number of issues. The list can be manipulated to help determine the most efficient use of campaign resources. Sales volume is in four figures, and the entrepreneurs say, "We're making money."

This is the year many of our classmates become full-fledged M.D.s. Among them, **Sherman Shlomo Elspas:** "Here's my latest news—I'm graduating from U.C.L.A. Medical School in June, doing a medical internship at Kaiser-San Francisco, then a residency in anesthesiology at Harbor-U.C.L.A. Medical Center." . . . **Dalhoon Chun,** graduating from U.C.L.A. Medical School as well, reports that he will be spending one year at Wadsworth V.A. Hospital in West Los Angeles. . . . From **Su-**

san Wildin: "I graduated from Baylor College of Medicine in May, and start a residency in pediatrics at the University of Texas Medical Branch, Galveston, in July." . . . **Nancy Cho** is glad to say that she and **Mike Schiffman** have received M.D.s from N.Y.U. Medical School. Nancy will be doing a stint in internal medicine at Mount Sinai Hospital in New York, N.Y.

Other advanced degree recipients this year include **Peter Schecter,** who writes, "I am in my last year of law school at Boston College. After a trip to Europe this summer, I will be joining a patent law firm, Darby and Darby, in New York City." . . . From **David Trumper:** "I'm currently finishing my master's degree at M.I.T. and am looking forward to entering the Ph.D. program after taking the oral exam this spring. I plan to do research in analog circuit design. This summer I'm taking off from school and plan to go bicycling—perhaps cross-country." . . . Other Ph.D. candidates I have run into recently: **Eric Balles,** with the mechanical engineering department, came back to the 'Tute in 1982 for graduate studies. . . . **Laura MacGinitie** and **Carey Rappaport** are with Course VI. I ran into Laura at a recent crew team banquet (1984 marks 10 years of women's crew at M.I.T., as well as the 30th anniversary of the light-weight men's winning the Henley in England. The menu featured the legendary **Joan Whitten Miller** lasagne). Actively pursuing her Ph.D. Laura still finds time to work out on the river and occasionally to help coach a team. I ran into Carey in Harvard Square. A resident tutor at East Campus, he was shepherding a group of his charges about.

Amer Iqbal has started his M.B.A. at Wharton after three years of designing disk controllers in San Jose. . . . **Tabetha Frey McCartney** left Wharton with an M.B.A. this past May, and with a daughter as well. Tabetha and her husband, Lee, became the proud parents of Kyla Gay on April 10. . . . From **Richard Kocinski:** "I'm still living, working, and running in Arlington, Va. Greatest recent thrill was politicking for Gary Hart's triumph in New Hampshire." . . . From **Tomas Gonzales** (who says he staged quite the battle with an I.B.M. typewriter to get his message out): "I am still working for Trans Tech Caribe here in Puerto Rico on the design and start-up of a truck and equipment assembly and remanufacturing operation. In case you haven't heard of remanufacturing, read R. T. Lund's article in the Feb., March issue of *Technology Review*. I will be planning a mountain-climbing expedition to the Cordillere Blanca, Peru, later this year, with a short side trip to Portillo, Chile, for some skiing. . . . **James Bell** writes that he is president of his own company, Semi Disk Systems, in Beaverton, Ore.

Sue Jackson, '82, writes a long letter about the escapades of some members of the Class of '80, among them her brother, **Jim Jackson**. In November, 1983, Jeanne and **Gary Engleson** welcomed their first child, Michelle. She arrived just in time to accompany their parents to Jim's wedding in Tucson. Jim married Suzanne on December 31, 1983, and was heard "muttering something about a tax break." Both Jim and Gary are still working at Digital Equipment in Shrewsbury, Mass. Also at the wedding were **Seth Alford** and his wife Rose. **Dan Metzger,** another member of this group, is finishing his third year of medical school at Case Western in Cleveland.

Hats off to **Joel Fajans:** in selling the rights to a 3-D graphics display system developed partially with UROP funds, he requested that part of the first year's royalties go to UROP. Joel spent a significant amount of time working on it while he was an undergraduate. Credit goes to his father as well: Jack Fajans, Ph.D.'50, dean of the graduate studies at Stevens Institute of Technology, came up with idea several years ago. The rights have been purchased by a New Jersey firm.

By the time this goes to press, I will have received my M.B.A. from Harvard, and will hopefully have found the lucrative as yet elusive job.—**Debra A. Utko,** Assistant Secretary, 13A Soldiers Field Pk., Boston, MA 02168

81

We're communicating through releases instead of letters these days, as our activities grow more impressive. **Michael McCue** was recently named a Metropolitan Life Foundation fellow, in recognition of his work in health sciences and technology at M.I.T. . . . The Air Force sends a notice that **George Biondi** has successfully completed officer training school and has been commissioned a second lieutenant assigned at Sheppard Air Force Base, Texas.

A wonderful letter comes from **Marc Freedman,** who writes, "Like my classmates, I have settled down and am getting old. I married a beautiful, *intelligent*, California blonde, Cheryl Williams. She's an office manager and hopefully soon to be mother and housewife. We live with our two cocker spaniels in a condo in Anaheim. I work as a technical marketing analyst for Infodetics. I regret to report that I will not make my first million by age 25. Oh well, what's another year or two or ten?"

Nick Adams wants to let everyone know that he and his wife, Theresa, have relocated to Cambridge. Nick has just finished his first year at the Fletcher School of Law and Diplomacy at Tufts. In his spare time, Nick is starting a biotech firm, *Genetic Harvest*. . . . **Claudia Perry** is still writing about rock-and-roll for the Florida *Times-Union*. Claudia says she occasionally misses *Thursday*, but "never *The Tech*!" . . . **Katy Gropp** is in her third year at University of Florida Veterinary School. . . . **Paul Mahoney** writes that he will be graduating from Yale Law School and will begin clerking for the Hon. Ralph K. Winter of the U.S. Court of Appeals for the Second Circuit.

David Kazdan is finishing up his junior year of medical school at the University of Cincinnati and will be at N.I.H. in Bethesda, Md., in the fall. . . . **Cynthia (Zennetos) Peltier** writes that she married **John Peltier** in June, 1983. They both finished master's degrees in 1983, in nutritional biochemistry and metallurgy, respectively. Jon is working on his Ph.D. at M.I.T. while Cynthia is working on hers at Tufts. Cynthia writes that they probably won't be having children for a while since they now have 50: they serve as tutors at 500 Memorial Drive. . . . My favorite note this month comes from **John Castellano**, who writes that his life consists of "Skateboarding! Landsailing! Slalom racing! Off roading! Off-road biking! Hot VWs! California girls! YOW!" Not bad, John.

Word has reached me of the deaths of three of our classmates: **Jonah Garbus,** December, 1982; **Pramod Manaloor,** 1984; and **Guice Vander Linden III,** February, 1983.

On a better note, I want to thank **Steve Solnick** and **Mitchell Brook** for doing guest columns over the past two issues. I don't mind telling you that it feels good to be back at the typewriter again. I'm pleased to announce that I am *finally* receiving my degree from this hallowed institution. I believe my department in its wisdom decided they'd simply had enough of me. After working as a sailing counselor all summer (tough life), I will be starting this fall at Bain and Co., a consulting firm here in Boston located at Copley Place. A fraternity brother recently remarked, "Well Charles, it looks like you're finally going to do something with your life."

Winner of this month's Honorary Class Secretary award for the most news about everyone else is **David Slobodin**. The rest of this issue's news comes from David, who is currently in his third year at Princeton, working towards a Ph.D. in E.E. He has just passed his general exams and that his research involves new materials for solar cells. . . . Josephine Lee, '82, Joey Minahan, '82, and John Lafferty, '82, are at Princeton too. . . . Alan Albin, '80, is probation officer for Suffolk County, N.Y. . . . Armen "Pie Man" Avanessians, '82, is working for Bell Labs in Murray Hill, N.J. . . . **Max Sirrine** is married and about to be a father; he currently works as a corrections officer at Wallkill Prison in New York. . . . **John Lawrence** and Dave Mellinger, '83, have been touring the U.S. in a VW van. . . . **Victor Kuykendall** is alive and well and working in Indiana. . . . **George Lesieuture** and his wife, Annie, are looking for a new house near Los Angeles. George works for a small company and is studying for a Ph.D. at the University of California at the same time.—**Chuck Markham,** Secretary, Box 54, M.I.T. Branch, Cambridge, MA 02139

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Alan Laves is engaged to Rose E. Palmer. Congratulations Alan! . . . **Ginny Gozzo** is working at the Rome Air Development Center (RADC) in Rome, N.Y. RADC is part of the systems command of the U.S. Air Force. Ginny says, "My job says I'm an electronics engineer, but I do more paper pushing than anything else." She is working in the Intelligence and Reconnaisance Division. Ginny spent last summer in Hawaii. (I spend my summer "vacations" visting my folks in Rochester, N.Y.) Ginny has been in touch with a couple of other classmates. She says **Young Jae Kim** is living in Lowell and working at Wang Labs. . . . **Eumi Pyun** is living in Danielson, Ct. (literally the "sticks" in Ginny's words) and working at Roger's Corp. Eumi, say hi to **Ed Maxwell** if he's still there. . . . **Allegra Hakim** was visiting Ginny and says they "spent the time lounging around peeling grapes and practicing wild abandon." (Ginny says that the part about peeling grapes isn't true.) Allegra's settled in the "heartland" of America, Dayton, Ohio. She's an "almost first lieutenant" in the U.S. Air Force at the Aero Propulsion Lab. Allegra's kept up with fellow alumni. Dave Hills, '81, **Chris Daehnick, Bryan Forston, Pete Rogers,** and **Chris Gunning** all work at Wright-Patterson Air Force Base. . . . **Steven Taylor, Steve Nolet,** and Dave Herring, '83, have passed through town.

Yahya Muhaimin is a faculty member in Social and Political Sciences, Gagjah Mada University, Indonesia. As well, he is co-director of the post-graduate program there. He's also chairman of the Educational Foundation, managing a kindergarten, two elementary schools, a female vocational high school, and a senior high school. In his spare time, he does his research and writing. . . . **Steven Williams** writes that he graduated from Carnegie-Mellon University with an M.S. in industrial administration. . . . **Austin Puglisi** is finishing up an M.S. in biology from the University of Michigan and will then seek a job back in the Northeast. . . . **John Ralston** sends a warm hello to all the '82 folks. He's currently in graduate school at Cornell where two other '82 grads turned up. . . . **Eric Elias** and **Alison Schary** are both in John's research group.

Howard Benjamin says he's been busy passing qualifying exams. Howard asks the question that is on everybody's mind these days, "Where is **Evan Morris** now?" Funny you should ask, Howard, because Evan says "I'm here in Cleveland, which is not the all-American city you might have thought in some moment of complete deliriousness. Evan comments on the lack of mail he's received from his friends. The M.I.T. Biology Department wrote him a letter that began, 'Dear Biology Major.' " They invited him to a party to meet his fellow undergraduate bio-majors. Evan says, "I don't know if I should be insulted that they don't know I've graduated or grateful that they didn't ask for money." If you're wondering what Evan is doing in Cleveland (I think he's wonderful!), he's in graduate school at Case-Western. Hope to hear from the rest of you soon!—**Rhonda Peck,** Secretary, 38 Bigelow St., Cambridge, MA 02139

83

Stephen Defalco writes that he has tied the knot, but he doesn't mention his wife's name. He is

working towards his master's in electrical engineering part time at Syracuse University. . . . **Layton Montgomery** sends a letter telling us of his recent activities. Layton has started the long application process for the U.S. Peace Corps and is under consideration for teaching mathematics in the secondary school in Botswana, South Africa. . . . **Eric Johnson** writes in that he is absolutely flabbergasted with all his recent publicity on hating MIT coeds. He says that he is tired of trying to clear his name and decided to simply say hello! . . . We have a marriage announcement for **Denise Anne Brush** and **James Patrick Roberts**. The wedding took place on April 14. . . . I mustn't forget to congratulate **Michael Cafferty** on winning the M.I.T. Club of Southern California Scholarship. . . . As for myself, I am happy to announce that I have received my master's in Business. One can safely deduce that I completed my thesis. I am off to Europe for the summer. I have accepted a job with I.B.M. on Wall Street, and I shall be starting there in September.—**John E. De Rubeis,** Secretary, 47 Gillette Ave., Sayville, NY 11782

'84

Well, folks, this is my first column for the *Review*. In searching for some appropriate introductory remarks for this momentous occasion, I could only come up with the following: I sincerely hope you enjoy reading this column for the next five years since I'm sure I'll enjoy writing it.

Speaking of momentous occasions, I take pleasure in announcing the recent or in-the-near-future marriages of some of our classmates. **Mark** and **Rachelle Ensio** were married last year; this pair of Floridians, both of whom received degrees this past June (Mark in Course X and Rachelle in Course II), plan to take a short vacation and then return to M.I.T. where Mark will finish his master's at Course X's Practice School. . . . Another fellow chemical engineer, **Hau Yee Ng** officially tied the knot with Edmond Lo immediately after finals. . . . Two more chemical engineers, **Teresa Leong** and Bill Mock, '79 (Bill received his Ph.D. this June) were married on June 2; they will both be working for ASPEN in the Boston area. . . . Course X colleague, **Mary Kay Biscan,** will marry Lloyd Townley, former Burton 2 floor tutor, and then settle in Australia where the market for chemical engineers is hopefully better. . . . **Cliff Denker,** yet another Course Xer, will lose his bachelorhood next January when he exchanges vows with Jill Solan, a Simmons graduate; Cliff will attend Practice School this fall. . . . **Catherine "Katja" Mamalakis** will be marrying Mark "Cydell," '83. To all these couples, I extend my congratulations and warm wishes for a happy future.

Tim Chambers will be working for Hewlett-Packard in Colorado Springs, Colo., trying to save enough money to purchase a car as well as other items; before starting work, he plans to travel around the country, stopping by Birmingham, Ala. "for no particular reason." . . . **Mark Robien** "who has never made out in a car larger than a subcompact" plans to be at Wellesley College next fall to work on a second bachelor's, in physics. . . . While playing tennis the other day, I ran into **Mark Tarpinian,** an awesome leftie BTB and one of my all-time tennis heroes, and learned that he will give up coaching tennis to work for a semiconductor firm in California. I had the privilege of hitting with Bill Ransohoff, younger brother of M.I.T.'s varsity tennis star, **Tom Ransohoff**. Bill informed me that Tom will work at home "for dad" during the summer and attend the University of California, Berkeley next fall in chemical engineering. Bill also informed me that **Betty Beitz** will be working nearby (what a coincidence) in San Jose for IBM. This bit of gossip was later confirmed by **Suzanne Greene** who will be rooming with Betty in San Jose.

I was playing mixed doubles with **Mona Wan,** her sister Pauline, and **Tom Chen,** when I learned that Mona will give up her Burton desk staff captaincy to work for Tektronix in Beaverton, Oregon this summer, after which she will attend Stanford, studying towards a Ph.D. in chemical engineering. Tom will follow Mona out west to the University of California, Berkeley where he will work toward a Ph.D. in electrical engineering.

Dan Christopher Lyman has been accepted into the U.S. Navy's Nuclear Power Program, but will first spend one summer working in the Pentagon on classified material "which is very top-secret" and "unrelated to frisbee golf."... **Norris L'Octobrique** laments that there is not a great deal of demand for civil engineers and is still searching for employment in the construction industry.

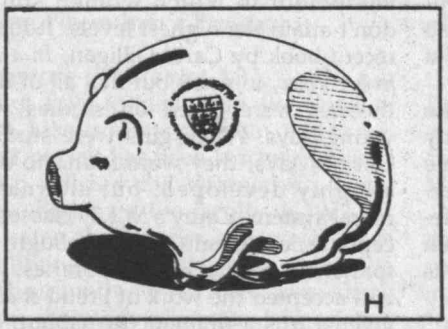
I spoke briefly with **Bruce Kinzinger** and his lovely sister, Jean, and learned that Bruce will be working for MITRE Corp., in McLean, Va. for 15 months while applying to medical schools. His brother, **Arthur Kinzinger,** has finally finished his thesis on which he has been working part time and graduated in June with our class; he plans to continue his job in Boston full time. . . . **Andy Dahl** will be working for Eaton on semiconductor sales; Andy's father opined that if four years of a costly M.I.T. education had only trained his son to be a saleman, he'd "better be a damn good one." . . . **Laura Motz** will continue to work for a law firm until she is certified to teach in Massachusetts; she then plans to teach in the public elementary and secondary school system. . . . **Bill LaPointe** will be working for Proctor and Gamble as a process chemical engineer in the Boston area.

The two musketeers, **Kim Isenberg** and **Rhonda Schaeffer,** finished the harrowing experience known as Chemical Engineering Practice School. Kim will work for Digital Equipment Corp. Rhonda will attempt to break into the modeling scene in New York; if that does not work out, she will return to Cambridge to work for Polaroid. . . . **Layne Yamada,** champion wrestler and renowned stud, will return to Hawaii and work for the phone company. . . . **Kyu Ho Lee,** who claims credit for the phrase "introductory remarks" used earlier in this column, will be attending John Hopkins Medical School in Pennsylvania next fall.

Grant Johnson intends to "hang out" in Colorado for the summer before going off to the unsettled, uncivilized Northwest to work for Fairchild in Seattle, Wash.

Paras Sphicas will also abandon civilization when he goes overseas to southeast Asia to work as a Schlumberger field engineer. In fact, Paras turned down an offer to do graduate work in physics at M.I.T. to work on an oil rig. . . . **Mike Snyder** is similarly going to "rough it" in the wilds of the Midwest, working for Proctor and Gamble in Cincinnati, Ohio. . . . I, myself, prefer to stay closer to home. I'll be returning to M.I.T. this fall as a graduate student in biochemical engineering. Mail should be sent to me at my summer address (it will be forwarded if I move). I look forward to hearing from you!—**Peter Tu,** Secretary, 410 Memorial Dr., Cambridge, MA 02139

M.I.T. *Insignia*



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Women's Studies: New Program Hits the Ground Running

"What I am struggling to do is pay adequate attention to the accomplishments of women," says associate professor of history Arthur Kaledin. But when he first became interested in raising questions in his classes about the roles of women in American cultural and intellectual history, he found that his own traditional education was not much use: "the old training gets in the way." What's more, there was little material available that he might incorporate into a syllabus and no obvious place at M.I.T. to go for help.

Ultimately, he was able, with the help of feminist scholars on campus, to locate materials which enrich his classes. He found, for example, that women have played a major role in all the spiritualist religions in this country, and that at least half the indigenous American religions were started by women.

"It required a lot of learning for me," Kaledin says, "and it is still a matter of trying to find out what is out there." However, now that M.I.T. has a formalized Women's Studies Program, coordinated support is at hand.

Appointment Launches Program

The Women's Studies Program was launched last summer, when Ruth Perry, senior lecturer in humanities, was appointed director. Although it was not until the fall 1984 edition of the calendar that it was listed as a separate, interdisciplinary program with a core curriculum, Women's Studies already has had a busy first year.

During the January Independent Activities Period (IAP), Perry and administrative assistant Mary Wyer helped to organize a workshop on "Women in Biology" which brought the six women faculty members in the Biology Department together in the same room for the first time and triggered a continuing discussion. That was followed by a four-part seminar on "Gender and Science," which drew steadily larger audiences until it filled a 200-seat auditorium. Perry and Wyer also put together a comprehensive bulletin on activities in the Greater Boston area of interest to feminist scholars. And the program's quarters in the Hayden Library have been established as a comfortable setting where information and research resources—books, journals, reprints, and bibliographies—are developed and accessible.

Those activities will continue. But the bread-and-butter concern for Women's Studies is the special character of the subjects included under its umbrella, and its role as a catalyst in the development of new curricula and provider of scholarly support for new and existing subject offerings.

Perry's own class, a section of Introduction to Fiction, HUM-D 21.003, illustrates some of the ways Women's Studies classes are distinctive.

First, there is the content. "Many literature classes rely on the work of male authors, though the instructors don't see any need to comment on that fact," Perry says. "But I do." Her class deals exclusively with texts by women authors, and some attention is paid to the difference gender might make in the author's view of her world. (Perry's is also a class that teaches how to read, how a work of fiction is constructed.)

Then, there is the composition of the class. Typically more women from any pool sign up for classes on the female experience. At M.I.T., with an undergraduate population only 24 percent female, that leads to a 50/50 ratio of men and women among the 20 or so students in Perry's section.

And there is her "charge to the class." She tells the men in the group that they are "party to privileged information—the male experience. I expect them to be alert, to report when the authors fail to depict three-dimensional male characters." Which they did—concluding that there are no fully-drawn male characters in the novels by British novelist Doris Lessing. Perry agrees with their assessment. On the other side of the slate, the students found that in *The Professor's House* by Willa Cather, the story is carried along by strong male characters.

The men and women in her class "are like two tribes, living side by side, suddenly having the opportunity to share information," Perry says, and the interaction is "wonderful."

"Pan-disciplinary" Studies

Although the largest number of M.I.T. Women's Studies subjects are found in English, European, and Latin American literature, these fields don't have a corner on the market. Nearly 20 faculty members teach subjects in Women's Studies, and special projects are offered in Linguistics and Philosophy, Psychology, Political Science, Urban Studies and Humanities. There are opportunities to pursue gender-related topics in the Sloan School of Management, the Program in Science, Technology and Society (STS), and the Experimental Study Group. Special independent study and UROP projects can also be arranged with faculty members affiliated with the Women's Studies Program.

What can a Women's Studies perspective add to traditional disciplines? Susan Carey, professor of psychology, offers one example. The giants in the area of moral development are Freud, Piaget and Kohlberg, Carey explains, and they define patterns of moral development in which women simply don't attain the highest levels. It took a recent book by Carol Gilligan, *In a Different Voice*, to point out that all of their theories were based on studies with young boys. When girls were studied, Gilligan says, they were found to have a highly developed, but alternative moral system. Carey's M.I.T. classes accept the new insight readily enough. But for herself and her contemporaries, who had accepted the work of Freud *et al.* as givens, it is a dramatic turnabout, and opens up challenging new questions in areas where gender was once assumed to make no difference.

In anthropology, reports associate professor Jean Jackson, Women's Studies has not only legitimized looking at

ILLUSTRATION: WOMEN'S STUDIES LOGO

Director of Women's Studies Ruth Perry (left) and assistant Mary Wyer.

aspects of culture once thought unimportant, but has changed the way ethnographers do their work. For example, asking only men about marriage customs among the Australian Aborigines yielded the "official" version, Jackson says. But now, when they interview the women as well, researchers find that women have a lot more informal power than they had been led to believe. She attributes the new approach in her field to the entry of more women and to the fact that both men and women investigators are now much more self-aware of the assumptions they might bring along from their own cultures.

In management, students and faculty have studied the role of Black women in the labor market and the impact of dual career families, Perry reports. In urban studies, there are researchers looking at the special needs of women and children that should be programmed into planning for housing and commercial spaces.

The list grows daily. In terms of the number of new questions which have never been addressed before, Perry says, "Women's Studies is one of the most energized areas in the academy."

Fitting Pieces into a Program

Women's Studies at M.I.T. did not spring fully-formed from the head of Hera. Like any new program, it evolved. Perry herself has been teaching courses which utilized the writing of women since she joined the faculty in 1972. At the same time, other academics were identifying and challenging gender-related assumptions in their own disciplines, but they all worked in relative isolation. Arthur Kaledin was able to tap into anthropologist Jean Jackson's wide knowledge of the feminist literature only because their offices were down the hall from each other.

In 1980, about 10 of these faculty members formed a committee chaired by Jackson. They assembled and distributed a list of subjects which incorporated some content related to gender and then negotiated a humanities concentration in Women's Studies for students taking at least three subjects on that list.

Two years later, buoyed by growing student interest in Women's Studies and encouraged by the Institute's efforts to attract more women students, the committee began discussions with the administration about more formal support and structure for the discipline, culminating in the apointments of Perry and Wyer and the allocation of offices and a research room.

For Openers: The Broad View

One new core subject has been developed for the program—"Introduction to Women's Studies." The class will draw on literature, history, psychology, philosophy, and feminist theory and will consider such topics as women's role in the gender division of labor, gender and science, the social construction of sexuality and sex differences, the influence of race and class in women's lives, and images of women through literature and the arts. It will be taught this fall by Perry and Margaret Anderson, director of Women's Studies at the University of Delaware and a visiting lecturer at M.I.T.

Perry believes these classes help students to explore the traditional roles that society posits for both males and females. Arthur Kaledin agrees.

"This is a time when these issues are of enormous importance for men and women. The old divisions of labor have been abandoned; the new ones are not yet clear; and students are concerned about what is expected of them," Kaledin says. While student interest in Women's Studies has been consistently high, Perry reports, scholars in the field have not come in for their fair share of academic rewards—in the form of jobs, promotion and tenure.

But all that is changing. There are about 500 women's studies programs in the country and specialists in women's studies are being actively recruited by search committees at the major universities. Respected departments, such as the Princeton English department and the history department at the University of Wisconsin, Perry says, are building major graduate programs starring well-known feminist scholars. Graduate programs are in place at some 50 institutions, including the Univeristy of Chicago, Rutgers and Yale, and a Ph.D. is available. Close to 30 journals are devoted to feminist scholarship, including the new Boston-based *Women's Review of Books* and Perry finds that most publishers have a women's studies section in their offerings. "The history of women is being collected and recorded—mapped for the first time," Perry says.

The new, tenured faculty are particularly vital, she says, because they will train the graduate students who will teach the next generation of students, ensuring the survival of women's studies beyond its present fashionable phase.

Doesn't Have to Last Forever

Women's Studies may not have to be long-lived as a separate program to be successful, Perry points out. Her own goals would lead ultimately to the integration of women's experience into all relevant disciplines, an approach describes as "mainstreaming." But there is another view—sometimes characterized as "ghetto-izing women's studies"—whose proponents believe that the survival of serious scholarship on women can only be safeguarded through a separate program. Which view will prevail is an unknown at this point. But the first steps for either set of objectives are the same: developing and teaching new scholarship, creating a body of resource materials on women in all relevant disciplines, and developing a student constituency which will demand "adequate attention to the accomplishments of women."—SUSAN LEWIS

Courses

I
Civil Engineering

Three members of the department at M.I.T. have been promoted to the rank of full professor, effective July 1:

☐ **Mohsen M. Baligh,** a theorist in the geotechnical field; he has developed a long-range research program for the solution of important practical problems on the basis of analyses of actual soil behavior.

☐ **Rafael L. Bras,** '72, a leading hydrologist whose interest is in the interpretation of natural phenomena as random functions.

☐ **Ole S. Madsen,** Sc.D.'70, an expert in hydrodynamics whose special field is sediment-fluid interaction in the coastal zone and continental shelf.

Four of the department's faculty and former students were honored by membership in the National Academy of Engineering, recognizing their contributions to engineering theory and practice and unusual technological accomplishments, late last spring. The four:

☐ **Harl P. Aldrich, Jr.,** '47, senior principal and president of Haley and Aldrich, Inc., Cambridge, "for fundamental contributions to understanding freezing problems and preloading techniques, and for leadership in the development of geotechnical engineering practice."

☐ **John W. Leonard,** '47, vice-president—engineering, Morrison-Knudsen Co., Inc., Boise, Idaho, "for innovative application of engineering to major construction projects, especially in the areas of mechanized tunneling and coastal and harbor construction."

☐ **Peter W. Likins,** S.M.'58, president of Lehigh University, "for contributions to spacecraft dynamics and control and for leadership in engineering education through teaching, research, writing, and academic administration."

☐ **John H. Schmertmann,** '50, principal in Schmertmann and Crapps, Inc., Gainesville, Fla., "for design methods in geotechnical engineering based on innovative field test methods and careful laboratory research."

Paul H. Robbins, S.M.'36, recently wrote *Building for Professional Growth: A History of the National Society of Professional Engineers 1934-1984,* published by NSPE as part of the Society's 50th anniversary celebration. (Robbins served as executive director of NSPE from 1946 to 1978.) The text explores major issues that have confronted the engineering profession in the past 50 years and relates "how NSPE has worked to meet many of these challenges." . . . **Brian C. Kullman,** Ph.D.'73, is senior vice-president of marketing and sales for Ryder/P.I.E. Nationwide, Jacksonville, Fla.

II
Mechanical Engineering

Professor **Haruhiko Asada** in the department and the Laboratory for Manufacturing Productivity at M.I.T. has received a 1984 Outstanding Young Manufacturing Engineer Award from the Society of Manufacturing Engineers. Asada is noted for his invention of a direct-drive robotic arm requiring no gearing. . . . **William R. Murray,** a doctoral candidate in the department at M.I.T. has won the Association for the Advancement of Medical Instrumentation's 1984 Student Manuscript Award for his paper, "An Optimal Real-time Digital Processor for the Electrical Activity of Muscle." . . . **Eric G. Newberg, Jr.,** S.M.'46, a retired commander in the United States Navy who is currently an engineering manager and project engineer at the McLaughlin Research Corp., Middletown, R.I., has been appointed by the Inter-Church Council of Greater New Bedford (Mass.), Inc., as development director to lead its fund-raising efforts for 1984-85.

Joseph L. Smith, Jr., Sc.D.'59, professor in the department at M.I.T., was honored by membership in the National Academy of Engineering late last spring. His citation: "for pioneering contributions to the analysis, design, and fabrication of superconducting synchronous alternators."

Donald J. Spooner, S.M.'52, has been appointed manager of the Advanced Technology Program at the U.S. Apparatus Division of Eastman Kodak Co., Rochester, N.Y. Spooner has been with Kodak since 1952, most recently as managing engineer, product engineering, of the Advanced Technology Program. . . . **Daniel J. Lynch,** S.M.'72, assistant professor at Dartmouth College's Thayer School of Engineering, has been awarded a President's Young Investigator Award in the form of a National Science Foundation grant. Lynch is devoting most of research time to "developing computer methods for a broad spectrum of science and engineering problems"—based mostly on his expertise in the finite-element method. . . . **Bharath S. Bagepalli,** Ph.D.'84, has joined the General Electric Research and Development Center, Schenectady, N.Y., as a mechanical engineer.

William Menoher, S.M.'40, a retired colonel in the United States Marines, passed away on October 23, 1978; no further details are available.

III
Materials Science and Engineering

Professor **Mildred S. Dresselhaus,** director of the Center for Materials Science and Engineering at M.I.T., has been appointed to the Department of Energy's Research Advisory Board. . . . Professors **Gregory Oreper, Julian Szekely** and **Thomas W. Eager,** Sc.D.'72, received the Charles Jennings Memorial Award of the American Welding Society in recognition of their 1983 paper, "Convection in Arc Weld Pools" published in *Welding Journal.* The paper was cited as being the "most valuable contribution to welding literature."

Professor **W. David Kingery,** '48, now holds the Kyocera Professorship in the department at M.I.T. The award reflects Professor Kingery's "major impacts" on ceramic science and education, says Professor **Merton C. Flemings,** '51, head of the department; the professorship is the result of a $350,000 grant (five years) from Kyocera Corp. of Kyoto, Japan, formerly known as the Kyoto Ceramics Co., Ltd. . . . Professor Kingery was further honored last spring by election to the American Academy of Arts and Sciences, the Cambridge-based honorary in the sciences and social sciences.

Membership in the National Academy of Engineering came last spring to **Robert Mehrabian,** Sc.D.'69, who is dean of the School of Engineering at the University of California, Santa Barbara. His citation: "for significant and timely advances in the rapid solidification of alloy systems and in the novel casting of liquid-solid mixtures."

William B. Eisen, Ph.D.'68, former vice-president and general manager of Colt Industries, has been promoted to president of the firm's Crucible Compaction Metals Operation. . . . **Douglas J. Carlson,** a graduate student in the department at M.I.T., has been awarded the $325 William L. Hsu Prize in a competition sponsored by the M.I.T. Music Section for his brass fanfare—"Fanfare for Symphonic Brass." The piece was premiered last May at the M.I.T. Symphony Orchestra's 100th anniversary.

Michael D. Rechtin, Ph.D.'70, is a patent attorney at Welsh and Katz, Ltd., actively arranging venture capital for emerging high-technology companies. Rechtin is also on the Executive Committee of the M.I.T. Enterprise Forum of Chicago and chairman of the Formative Business Committee. . . . **Stanislaus A. Zygmunt,** '84, who received his S.B. from the department at M.I.T. in June, was chosen for the 1984 Falih Darmara Materials Achievement Award, sponsored by Special Metals Corp., Hartford, Conn. The award—presented annually—honors Professor Emeritus John Wulff's commitment to undergraduate teaching. (Wulff is the firm's retired board chairman.)

Teuvo J. Santala, Ph.D.'69, of Attelboro, Mass., passed away on October 29, 1979; no further details are available.

IV
Architecture

Among prizes and awards announced in the Film/Video Section at the end of the spring:

☐ The Silver Electra for the best videotape in the Birmingham, Ala., International Film Festival was given to "By World of Mouth: Storytelling in America," the thesis movie of **Steve Kostant,** S.M.'84.

☐ A grant from the St. Botolph Foundation will support the work of **Steven Albehari,** a masters' degree candidate in still photography, on man's interactions with the natural setting.

☐ "Silver Valley," of which **Michel Negroponte,** S.M.'78 was one of three directors, won the grand prize at the sixth "Cinema du Reel" ethnographic film festival at the Pompidou Cultural Center, Paris.

☐ **Mark Rance,** S.M.'77, won two special mentions for his "Death and the Singing Telegram" at the Nyon International Film Festival.

☐ **Ross McElwee,** S.M.'77, will continue work on

his documentary, "Sherman's March," under a Guggenheim Fellowship.

Adjectives and phrases used by Gene Thornton of the *New York Times* to describe photographs by Professor Emeritus **Gyorgy Kepes,** displayed early this summer at the International Center for Photography, New York: "beautiful" . . . "fascinating" . . . "preoccupation with light as an aspect of design" . . . "artistic roots in the Bauhaus tradition." Though most of the images are totally abstract, the photographs "seem to shine with their own inner light," wrote Thornton; they show Kepes' photography "as part of a large and varied activity in picture-making and design."

Inflatable structures by Professor **Otto Piene,** director of the Center for Advanced Visual Studies, were an essential part of a multi-media performance event at the Solomon R. Guggeneheim Museum in New York in June. "Skydance/Dancetime" received four performances by the Experimental Intermedia Foundation of New York (with support from the National Endowment for the Arts); Piene sculptures, launched during the performance from the museum's rotunda, were displayed on the building's Fifth Avenue facade.

The late **Robert B. Newman,** M.Arch.'49, was honored by eight of his colleagues at a "tribute" session of the spring (1984) meeting of the Acoustical Society of America in Norfolk. The speakers: **Richard H. Bolt,** adjunct professor of acoustics in the department at M.I.T.; **William J. Cavanaugh,** '51, lecturer in the Division of Architectural Studies at the Rhode Island School of Design; **Ewart A. Wetherill,** M.Arch.'58, of Bolt Beranek and Newman, Canoga Park, Calif.; **John H. Spencer,** chairman of the Department of Architecture at Hampton Institute; **Mark E. Schafer,** '79, of Drexel University, Philadelphia; **Jack B.C. Purcell,** M.Arch.'52, of Purcell, Noppe and Associates, Chatsworth, Calif.; **Theodore J. Schultz,** Boston; and **Leo L. Beranek,** a founding partner of Bolt Beranek and Newman, Cambridge. **M. David Egan,** S.M.'66, of the College of Architecture at Clemson University, chaired the session.

Six graduate students in the department at M.I.T. and one in urban studies and planning (Course XI) have been awarded 1984 student travel grants by the Aga Khan Program for Islamic Architecture. They are:

☐ **Tulay B. Artan,** "Research project in Turkey: The 'Selijukid Renaissance' in Eighteenth Century Eastern Anatolia, or is it 'Baroque'?"

☐ **Solomon J. Benjamin,** "Research project in India: Muslim Settlement in Ladakh, India."

☐ **Richard P. Brotherman,** "Research project in Turkey: A Survey of the Zan Grid, Artuquid, and Ayyubid Architecture of Southeastern Turkey."

☐ **Joy E. Hecht,** (Course XI) "Research project in Yemen: Impact of Migration on Indigenous Housing in the Yemen Arab Republic."

☐ **Rajesh K. Pradhan,** "Research project in India: A Visual and Analytic Study of the Hanji Community in Srinagar, India."

☐ **Cherie A. Wendelken** and **Zhu You-Xuan,** "Research project in China: Cultural Definition versus Aculturation of the Chinese Muslim, the Architecture of the Hui Religious Institutions in Eastern China."

Paul Woodrow Chrisman, Jr., Ph.D.'76, left M.I.T. expecting to take his new degree to a plasma fusion laboratory. But a lifelong love of country music triumphed, and Chrisman now plays as Woody Paul in the Riders of the Sky ensemble for the Grand Ole Opry in Nashville.

The Fiddlin' Physicist

Paul Woodrow Chrisman, Jr., Ph.D. '76, known on stage as Woody Paul, "King of the Cowboy Fiddlers," has fiddled his way through 44 states as a member of the country western trio, Riders in the Sky.

Since few research opportunites were open in his field upon graduation from M.I.T., Chrisman chose to pursue his real first love—music. Chrisman's interest in fiddle playing began when he was 11 or 12 years old growing up in Tennessee, and it developed under the instruction and guidance of his father. While at M.I.T. Chrisman played classical guitar only for enjoyment while pursuing his doctorate in fusion plasma physics, and it wasn't until his last year that Chrisman took his musical ability to the streets of Boston and Cambridge.

Chrisman's first year as a professional musician was as a member of the rock band Loggins and Messina. Then he returned to Nashville to work with Wilma Lee Cooper's Mountain Boys before he formed Riders in the Sky in 1978.

The group's music is based on the of style of the singing cowboys of the 1930s and 1940s. As a member of the Grand Ole Opry ("That's like having a tenured job at a university," Chrisman says), the group performs weekly on the televised "Tumbleweed Theater" and is on the road 250-300 nights a year.

"Everything is just great. . . . I'm real proud of the band and the contribution we're making to the art form, a medium that shouldn't be forgotten," Chrisman says.—*V.K.* ☐

Richard A. Bolt, principal research scientist in the Media Laboratory (the "architecture machine" group), is author of *The Human Interface: Where People and Computers Meet* (Belmont, Calif.: Lifetime Learning Publications, 1984). "As computer technology and society's use of computers continue to converge ever more rapidly," writes Dr. Bolt, "so the need intensifies to achieve a completely natural dialogue or interaction between machines and human beings."

The purpose of his book, he says, is "to examine the concepts and situations under which this desired interaction takes place or could take place."

Christos Coios, M.Arch.'76, has been named an associate in the Boston firm, CBT/Childs, Bertman, Tseckares, and Casendino, Inc., architects, landscape architects, planners, and interior designers. Coios has served as guest architectural critic at the Boston Architectural Center and at M.I.T., where he has been an instructor.

Celile Butka, M.Arch.'47, former professor of architecture at the Technical University of Istanbul (1950-1958), passed away on March 6, 1984. Following Butka's teaching in Istanbul, she came to New York to work with several New York-based firms (1960-1972) on such projects as the Women's Correctional Institute, Rikers Island; the Telephone Building, New York City; the American Airlines Building, J.F.K. International Airport; and the Equitable Building, Syracuse. After 1973 she devoted her time to research related to Turkish culture and to writing four books.

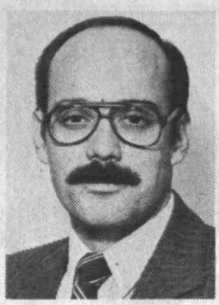
V

Chemistry

Professor **K. Barry Sharpless** of the department at M.I.T. was chosen late last spring for membership in the American Academy of Arts and Sciences, the Cambridge-based honorary society in the sciences and social sciences.

Lawrence R. Klein, Ph.D.'44, Benjamin Franklin Professor of Economics and Finance at the University of Pennsylvania and chairman of the scientific advisory board at Wharton Economic Forecasting Associates, is now a director of W.P. Cary and Co., Inc., New York City, where he is chairman of Cary's Economic Policy Committee. . . . **Robert A. Young,** Ph.D.'68, has been named president of IBM Instruments, Inc., Danbury, Conn., a subsidiary of International Business Machines Corp. responsible for developing, marketing, and servicing IBM's products in the analytical instruments field. Young has held several managerial and executive positions at IBM since joining the firm in 1968 as an associate systems engineer. . . . Professor **William Orme-Johnson** in the de-

M. Baligh



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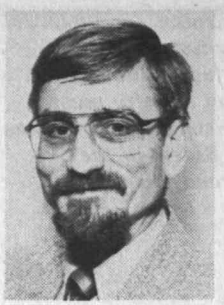

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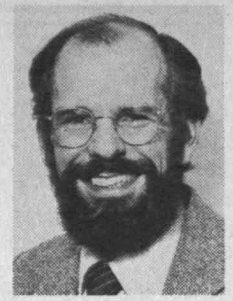


J. Kassakian

partment at M.I.T. is chairman of the Steering Committee of the first Gordon Research Conference devoted to research in the area of methanogenesis to be held on August 20-24 at the Tilton School, N.H.

Thompson M. Sloane, Ph.D.'72, formerly senior staff research scientist and leader of the Gas Phase Kinetics Research Group at the General Motors Research Laboratories, Warren, Mich., has been promoted to assistant head, of the Physical Chemistry Department. . . . **Orville L. Mageli,** Ph.D.'53, writes, "Retired January 1, 1983, from the position of vice-president—research at the Lucidol Division of the Pennwalt Corp. After 30 years with the company, I am now active as an independent consultant in the area of organic peroxides—use and safety." . . . **Raymond E. Goldstein,** '83, a graduate student in the department at M.I.T. has been named recipient of the 1983 Apker Award of the American Physical Society, "for his accomplishments as an undergraduate student . . . his research on 'Molecular Theory of Reentrant Phase Transitions in Binary Liquid Mixtures.' "

James M. Burlich, Ph.D.'65, reports that he is associate professor of chemistry, specializing in inorganic and organometallic chemistry, at Cornell University. . . . **Robert E. Kerwin,** S.M.'58, of AT&T Bell Laboratories has been named a 1984 Bell Fellow for the invention of the self-aligned silicon gate process. . . . **John T. Viola,** Ph.D.'67, has been appointed deputy for space test and director of the space test program at the Air Force Space Division, Los Angeles. Viola is responsible for providing space flight for Department of Defense experiments exploiting the space shuttle as a manned space laboratory. . . . **William D. Phillips,** Ph.D.'51, chairman of the Department of Chemistry at Washington University has taken on the additional post of senior vice-president—science and technology at Mallincrodt, Inc., of which he is a director.

John E. Sheats, Ph.D.'60, professor of chemistry at Rider College, Lawrenceville, N.J., has received the 1984 E. Emmet Reid Award for outstanding teaching and research work. "Sheats provides world-class research, enthusiastic but tough teaching, and dedicated service to the students of Rider College," a statement read. . . . **S. Donald Stookey,** Ph.D.'40, retired director of fundamental chemical research at the Corning Glass Works, Corning, N.Y., received an honorary doctorate of science degree during Alfred University's (Buffalo, N.Y.) May 12 commencement. Stookey, who has served as past distinguished visiting professor at Alfred, is inventor of the shatter-resistant glass-ceramic material used in "Corningware" products. He was cited for research discoveries that have "caused a virtual revolution in the field of glass science and engineering."

Three deaths were reported by the Alumni Association: **Alfred A. D'Addieco,** Ph.D.'46, a senior research associate at the E.I. du Pont de Nemours and Co., Grand Island, N.Y., died on March 11, 1984. D'Addieco, employed with DuPont for 35 years, held numerous patents and had written several articles for scientific journals. He was a member of the Amercian Chemical Society, the American Ceramics Society, the Sigma Xi Scientific Research Society, and the Grand Island Knights of Columbus Mary Star of the Sea Council. . . . **William H. Reinmuth,** Ph.D.'57, professor of chemistry at Columbia University, New York City, died on December 18, 1983; and **Virgil W. Ware,** Ph.D.'25, of Wallingford, Penn., on November 20, 1983; no futher details are available.

VI

Electrical Engineering and Computer Science

Five members of the department at M.I.T. have been promoted to the rank of full professor, effective July 1:

☐ **Alan J. Grodzinsky,** '71, a bioengineer whose research combines highly quantitative continuum electromagnetic theory with innovative experimental techniques on biological preparations.

☐ **Berthold K.P. Horn,** Ph.D.'70, a leading member of the Artificial Intelligence Laboratory whose interests are in the areas of machine vision, image understanding, spatial reasoning, and robotic motion.

☐ **John G. Kassakian,** '65, who has worked at bringing order into the field of power electronics, focusing on the relatively "heavy current" side of electrical engineering.

☐ **Gerald J. Sussman,** '68, a leading researcher in the field of artificial intelligence with special interest in programming language design, electric circuit design and VLSI design.

☐ **Alan S. Willsky,** '69, a specialist in the fields of control and estimation theory and of signal processing.

Hermann A. Haus, Sc.D.'54, Elihu Thomson Professor in the department at M.I.T., has been awarded a Fulbright Grant to the Technical University of Vienna, Austria, for 1984-85. Haus has played a significant role in developing the theory of high-frequency noise in electron devices and is respected for his teaching and research in electromagnetism and quantum electronics. . . . **Joseph Bordogna,** S.M.'60, Dean of Engineering and Applied Science at the University of Pennsylvania, who has been a significant contributor to several technological inventions—a laser-equipped cane that allows blind people to "see" where they are going, and the first laser voice-carrying system on Earth and later in space—has recently emerged as a spokesman for the "humanization" of engineering. "Millions of Americans who don't understand technology in a technological world are cutting themselves out of freedom of choice in our free society—they can't take the jobs that are out there because they don't have what we've begun to call 'technological literacy,' " Bordogna says.

Two graduate students in the department at M.I.T.—**Laura Yedwab** (computer science) and **Ellen Hahne,** S.M.'81 (electrical engineering)—were honored last spring with AT&T Bell Laboratories scholarships.

The awards—some 100 will be in place throughout the U.S. by 1986—cover tuition, books, and living and other expenses.

Two alumni of the department were honored late last spring by election to the National Academy of Engineering, recognizing their contributions to engineering theory and practice and unusual technological accomplishments. They are:

☐ **F. Paul de Mello,** '47, vice-presdient and principal engineer for Power Technologies, Inc., Schenectady, N.Y., "for major achievements in the dynamic analysis of electric power plants and systems benefitting design, control, and training applications."

☐ **Thomas Kailath,** Sc.D.'61, professor and associate chairman of the Department of Electrical Engineering at Stanford, "for outstanding contributions in prediction, filtering, and signal processing, and for leadership in engineering."

Roger H. Tancrell, S.M.'58, has been named a consulting scientist—the highest scientific level attainable—at Raytheon Co.'s Research Division, Lexington, Mass., "in special recognition of continually outstanding achievement over a period of time." Tancrell has held a series of increasingly more responsible positions at Raytheon since joining the firm in 1968; he holds seven patents, and has written many technical publications. . . . **Kanianthra M. Chandy,** Ph.D.'69, has been chairman of the Computer Science Department at the University of Texas, Austin, since September 1983. . . . **Leonard M. Magid,** Ph.D.'62, a central force in the creation of the U.S. solar energy program, has joined PA Consulting Services, Inc., Princeton, N.J., as a principal consultant. . . . **Curtis D. Brown,** S.M.'70, reports, "I've started a company to do research and development for the personal computer (PC) industry. Our first product is the PC Dialog, a voice mail solution for the IBM personal computer."

Professor **David D. Clark** of M.I.T.'s Laboratory for Computer Science, joined the board of directors of Proteon, Inc., Natick, Mass.

VI-A Program

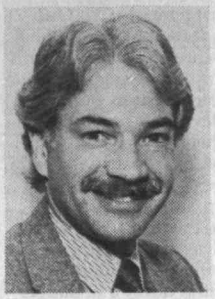
A delight of this year's "Technology Day," June 8, was the number of VI-A alumni who either visited the VI-A Office or were seen during some of the day's festivities. On the panel of speakers at the morning session was **Raymond S. Stata,** '57, president of Analog Devices, Inc. Ray was also elected earlier a term member of the M.I.T. Corporation.

Another alumnus John Tucker met at the morning session was Professor **Walter W. Turner,** '44, of the University of Maine. Walter recalled the occasion around 1957 when John Tucker, then on the National Board of Directors of the Eta Kappa Nu Association, was HKN's official representative at the installation of the chapter at the University of Maine.

Two other members of the 40th-reunion Class of 1944 who visited the VI-A Office together on Technology Day were **Holton E. Harris,** whose son Walter D. just completed his sophomore year in Course VI, and **Will B. Rodemann,** '44, vice-president of Control Data Business Advisors, Inc., of Minneapolis, Minn. During our discussions it came out that Messrs. Harris and Rodemann were both stationed at the Army's Central Signal Corps Training Center at Camp Crowder, Mo., during World War II where Director Tucker was also stationed. What a coincidence; it was the first time in the intervening 40 years that John met anyone who had also been at Camp Crowder!

G. Sussman

A. Willsky



C. Canizares

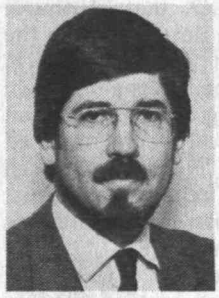
S. Carey

T. Poggio

G. Bitran

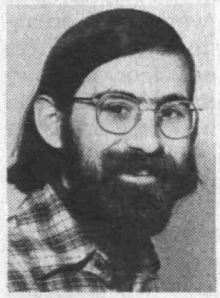
J. Hauser

P. Krugman



D. Lessard

E. Greitzer



D. Vogan, Jr.

W. Thilly

Other Tech Day VI-A visitors included **David M. Bernstein,** '74, now with TRW, Inc., Los Angeles; **Clinton C. Lawry, Jr.,** '39, retired from the General Electric Co.; **Karl A. Nyberg,** '79, member of the senior technical staff of Verdix Corp., McLean, Va.; **John N. Pierce,** '54, with Signatron, Lexington, Mass.; and Professor **David F. Tuttle,** '37, and his wife from Stanford, Calif.

Several of our visitors reported visits to Boston to visit Professor Emeritus **Karl L. Wildes,** '22, who is recovering at the Spalding Rehabilitation Hospital in Boston from a hip operation.

Several of our VI-A's were honored at the IEEE's Electro/84 centennial celebration in Boston in May. **Andrew J. Viterbi,** '56, president of Linkabit, here to receive the 1984 Alexander Graham Bell Medal, stopped by for a chat with VI-A Director Tucker. Amongst those receiving the Centennial Medals for outstanding contributions to IEEE were **Leslie J. Weed,** '27, and **Bruce D. Wedlock,** '56. John Tucker and 'Les' Weed served together in the Boston Section of the old AIEE back in the early 50's.

David E. Abrams, '76, stopped in for a visit the end of April and told us that he is now with a company called Natural MicroSystems which will be located in Natick, Mass., by the time this is published. In the middle of May we had a surprise visit from **Michael W. Patrick,** '79, who is relocating from TI in Houston to Ztel in Wilmington, Mass., to be near his fiancée who is serving as an intern at Cambridge City Hospital. The end of May brought an unexpected visit from **Daniel M. Naor,** '81, who was here on leave from Israel where he has one more year as an officer in the Israeli Air Force.

Chester M. Day, Jr., '57, is now with Bellcore, following the AT&T divestiture. He came in to talk with John Tucker about Bellcore's possible participation in the VI-A Program next year inasmuch as Bellcore is a spinoff from the former Bell Laboratories which is on VI-A.

Several have called to ask for help in filling positions at their companies. We talked with **Peter H. Dinnerstein,** '81, who is with Hughes/Electron Dynamics in Los Angeles and **Leon Ekchian,** '78, who called about a position with Optima Systems, Inc., R&D, Burlington, Mass. . . . **Daniel C. Cheng,** '81, dropped by and then sent us a posting for a position with Data Resources, Lexington, Mass.

Finally, to complete our lengthy list of visitors we had a pleasant visit from **Ludek Dadok,** '80, who is with Hewlett-Packard's Optoelectronics Division in Palo Alto, Calif.

Drop us a note if you have interesting VI-A information to pass along!—John A. Tucker, Director, VI-A Program, M.I.T., Room 38-473, Cambridge, MA 02139

VIII

Physics

Professor **Herman Feshbach,** Ph.D.'42, of M.I.T. is the president for 1984-85 of the American Academy of Arts and Sciences, the Cambridge-based honorary in the sciences and social sciences. And Professor **Bernard F. Burke,** '50, is chairman of the academy's Rumford Committee, to select the next winner of the prestigious Rumford Prize. . . . Professor **George B. Benedek** of the department at M.I.T. was honored with membership in the academy late last spring.

Professor **Vera Kistiakowsky** of M.I.T. has been honored by election to the grade of fellow by the American Association for the Advancement of Science. . . . An AT&T Bell Laboratories scholarship has been given this spring to **Andrew Millis,** a graduate student who's completing his first year in the department at M.I.T.

Claude Canizares has been promoted to the rank of full professor at M.I.T., effective July 1. Canizares, an experimental astrophysicist, has contributed greatly to the theory of the gravitational lens phenomena while pursuing his main research interests in x-ray and optical astronomy. . . . Professor **Kosta Tsipis,** director of M.I.T.'s Studies in Science and Technology for International Security, has been awarded the 1984 Szilard Award by the Forum of the American Physical Society. Tsipis was recognized "for applying his abilities as a physicist to understanding and publicizing both the technical and social aspects of important arms-race issues." . . . Professor **Walter H.G. Lewin,** in the department at M.I.T. since 1966, has been elected a recipient of a senior U.S. Scientist Award by the Alexander von Humboldt-Stiftung, a major research center in the Federal Republic of Germany. Lewin will be based (for one year) at the Max Planck Institute for Extraterrestrial Physics in Garching, near Munich—Europe's major astrophysics research center. . . . Professor **Harald A. Enge,** in the department at M.I.T. has been awarded the 1984 Tom W. Bonner Prize in Nuclear Physics by the American Physical Society. Enge was recognized "for his outstanding contributions to the design of magnetic spectrometers and beam optics in the field of nuclear physics."

Professor Emeritus **Victor F. Weisskopf,** who was director-general of the European Center of Nuclear Research (CERN) in Geneva from 1961 to 1965, was honored this spring with the **Julius Adams Stratton** ('23) Award of the Friends of Switzerland in Boston. The award, presented on Dr. Stratton's birthday each year, commemorates Stratton's own continuing interest in Switzerland, where (at the Eidgenossische Technische Hochschule, Zurich) he received his Sc.D. in physics in 1928.

IX

Psychology

Two members in the department at M.I.T. have been promoted to the rank of full professor, effective July 1:

☐ **Susan E. Carey,** an outstanding and innovative researcher in the field of cognitive psychology whose special interest is in the realm of concept formation and development.

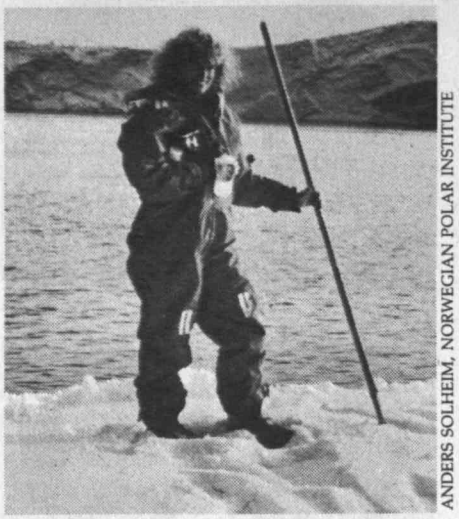
☐ **Tomaso A. Poggio,** a physicist turned neurobiologist who is now a leading theoretician in brain science; his diversified research interests are in neurosciences, computer science, vision science, and mathematics.

Assistant Professor **Steven Pinker,** in the department at M.I.T. has written *Language Learnability and Language Development,* which is awaiting publication (this summer) by Harvard University Press. The book reports a new theory on how children learn the grammar of their mother tongue, and it combines research in experimental child psychology, linguistics, and computer science. Pinker is also in the process of co-authoring *Graphs for Computers and People* (tentative title), which attempts to apply basic research in perception and cognition to the readability of graphs and charts. The book should appear in 1985, published by Rinehart and Winston.

X

Chemical Engineering

Miles G. Leverett, Sc.D.'38, who is a private consultant in the nuclear power field in Monte Sereno, Calif., was honored with membership in the National Academy of Engineering late last spring. His citation: "for pioneering contributions to nuclear reactor designs and for a broad range



ANDERS SOLHEIM, NORWEGIAN POLAR INSTITUTE

S. Pfirman

Summers in a Sea of Ice

Adventures that most of us could never hope to have will stand behind the Ph.D. that Stephanie Pfirman will receive next year from the M.I.T.-Woods Hole joint program in oceangraphy. For she has spent the last three summers doing thesis research on and in the Barents Sea, several hundred miles northwest of Norway and well within the Arctic Circle, as a scientist aboard the Norwegian Polar Institute's research vessel *Lance*.

The region is virtually unexplored. Pfirman's assignment was to identify glacial sediment from the region—part of a program in the world-wide oceanographic community to track the sources of sediment on the sea floor. Her surprising results: the glacial sediments in this remote part of the world stay close to the glaciers from which they come, because of currents and biological activity.

While aboard *Lance* Pfirman used instruments to measure suspended particles in the water, collected sediment cores, used sonar to study the sea floor, and even took bottom photographs. She snorkeled among icebergs, flew by helicopter to obtain samples that couldn't be reached by the ship, and worked on ice flows where scientists had to carry weapons as protection against polar bears.

When she first joined *Lance* the crew was skeptical—she was both a woman and an American. "But once I made a bowline they were fine," Pfirman says. □

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of contributions to enhance safety in the nuclear industry."

Robert J. Richardson, Sc.D.'54, formerly executive vice-president and member of the Executive Committee and Board of Directors of the Du Pont Co., Wilmington, Del., became president of Bell Canada Enterprises late last spring. . . . **Carl Sharon,** S.M.'77, a senior at the Lutheran School of Theology, Chicago, has been awarded a North American Ministerial Fellowship to pursue his vocation of a Christian minister. Sharon worked for Dynatech Research and Development Co., Cambridge, before beginning his theological studies. . . . **Wilbur A. Holve,** S.M.'55, reports, "After 25 years with Badger Engineers, I have formed my own firm, OPTEC, Ltd., in St. Helier, Jersey, Channel Islands, to offer *OP*timized *T*echno-*EC*onomic engineering design consulting services to the petroleum, chemical, and biotechnical industries. I was formerly technical director of Badger Ltd. and am presently a consultant on a British National Coal Board coal liquefaction project. I am also involved on refinery assignments in Europe and the Middle East. OPTEC Ltd. is associated with Kesler Engineering, Inc., and ENSYS Ltd., microprocessing specialists, both of New Jersey and with Meriel S.A., engineering management consultants of Paris."

Andre C. Deprez, S.M.'55, writes, "I took early retirement as vice-president of the Halcon SD Group and have established myself as a consultant in technology transfer and project analysis for a few international chemical/petroleum firms." . . . **Patrick E. Fowles,** Sc.D.'66, planning associate with Mobil Research and Development Corp., Princeton, N.J., has been re-elected a director of the American Society of Lubrication Engineers.

William M. Harp, S.M.'38, of Baytown, Tex., passed away on December 27, 1983; no further details are available.

XIII

Ocean Engineering

The Biennial Award of the Acoustical Society of America, for "substantial contributions through published papers to the advancement of theoretical or applied acoustics," was given late last spring to **Peter N. Mikhalevsky,** Ph.D.'79, associate profesor of ocean engineering at M.I.T. Professor Mikhalevsky was cited for work in "understanding the propagation of sound and the role of fluctuations in signal detection modeling." He had been at M.I.T. for only a few months when the award was conferred; it was based on his work in the field of underwater acoustics as a naval officer assigned to the Naval Underwater Systems Center and the Pentagon following his doctorate at M.I.T.

William T. Ellison, Ph.D.'70, writes, "After nine years as vice-president of Cambridge Acoustical Associates, I started my own company in July 1983. The company, Marine Acoustics, is principally active in research and design in underwater acoustics mainly in the Arctic; where we have developed a portable computer-based signal processing system for remote localization of whale sounds in the field." . . . **Robert K. Johnson,** S.M.'67, is president and owner of a yacht building company, producing the "Island Packet" line of 27- and 31-foot cruising sailboats in Largo, Fla., near Tampa Bay. . . . **Clark Graham,** S.M.'69, commander in the U.S. Navy gave a lecture of his work as designer of surface warships—"U.S. Naval Ship Design"—last March at the Coast Guard Academy in New London, Conn. Graham taught ship design at M.I.T. and has written more than 15 technical papers on the subject.

XV

Management

A new honor for Professor **Lester Thurow:** he was chosen late last spring for membership in the American Academy of Arts and Sciences, the Cambridge-based honorary society in the sciences and social sciences.

Michael A. Connolly, S.M.'82, reports, "Enjoying myself as director of research at Information Data Search, a Cambridge-based competitor research firm. Will be seeing Caroline Pitts in London this summer." . . . **Robert S. Hamada,** Ph.D.'69, professor of finance at the University of Chicago has been named a director of A.M. Castle & Co., Franklin Park, Ill. . . . **Ronald E. Fry,** Ph.D.'78, was recently promoted to associate professor of organizational behavior with tenure at Case Western Reserve University and received the 1983 University Award for Outstanding Teacher in Graduate and Professional Schools. . . . **Walter J. Popper,** S.M.'83, is working with Index Systems, a Cambridge consulting firm, in executive education and organizational development.

Marcos G. D'Agostini, S.M.'76, writes, "I have been living in London for the past four years as a director and general manager of the U.K. subsidiary of a Brazilian-based financial and insurance group. Would welcome visits from colleagues when next coming to the U.K." . . . **Roger F. Naill,** S.M.'72, vice-president for energy planning at AES, Inc., has co-authored *America's Least-Cost Energy Strategy—Creating Abundance* (Mc-Graw Hill), which "tells in detail of the impressive accomplishments of Americans in taming the energy problem" . . . demonstrating that individuals make a difference.

Walter C. Hinds, Jr., S.M.'62, a self-employed electrical engineering consultant working in Texas, died of a heart attack on March 31, 1984, while on a business trip for his current firm, Hinds Associates. Hinds had served as a vice-president of Texas Instruments, Houston; director of manufacturing for Emerson Electric, St. Louis, Mo.; vice-president of manufacturing at General Signal Co. in Rhode Island; and until his retirement in 1983 a vice-president of General Radio, Concord, Mass. During World War II he served with the U.S. Navy, and he was for five years employed by Standard Oil in Venezuela.

Four members in the Sloan School faculty have been promoted to the rank of full professor, effective July 1:

□ **Gabriel R. Bitran,** Ph.D.'75, an operations researcher whose interest is in the field of operations management; he has made major contributions to the theoretical foundations of hierarchial production planning and multiple-criteria decisionmaking.

□ **John R. Hauser,** '73, a management scientist whose main interest is in the area of marketing; known internationally for his studies in new product development and mathematical models of consumer behavior. Dr. Hauser's degrees are in electrical and civil engineering and operations research.

□ **Paul R. Krugman,** Ph.D.'77, regarded as a leading international economic theorist; his work has resulted in a major advance in understanding previously unexplained aspects of trade patterns.

□ **Donald R. Lessard,** a specialist in international management whose research has focused on international corporate finance and issues of economic development and industrial policy.

Sloan Fellows

Philip W. Lett, Jr., S.M.'61, vice-president for engineering in the Land Systems Division, General Dynamics, Warren, Mich., was honored by membership in the National Academy of Engineering late last spring. His citation: "For 25 years of technical and managerial contributions to the development of U.S. combat and tactical vehicle systems."

Three alumni of the program have new assignments with Conoco, Inc., Wilmington, Del.: **Floyd E. Ellis,** S.M.'70, executive vice-president—international production; **William K. Dietrich,** S.M.'71, vice-president—international production; and **H. Kent Bowden,** S.M.'68, is vice-president of the parent company as well as chairman and managing director of Conoco Ltd., England. . . . **Goff Smith,** S.M.'53, has retired as director of Amstead Industries, Inc., Chicago, Ill. . . . **Richard J. Howe,** S.M.'65, has been named to the

Board of Directors of Pennzoil Co., Houston, Texas, where he is group vice-president of communications and management support systems.

Management of Technology Program

The current students had a real treat in May when Dennis Oliver, chairman of the Electro-Optical Division of Pilkington Brothers in England, came to the "Manufacturing/Technology Interface" class and spent a morning with them. He gave a fascinating lecture on the development of the famous float glass process, invented at Pilkington over 15 years ago. An informal session afterwards over coffee and donuts gave the class a chance to ask more questions and get to know Dr. Oliver better.

In other Pilkington news, **Geoff Andrews,** S.M.'82, called Jane Morse in April from Pittsfield, Mass. He was only in the U.S. for a day, he said, so he wouldn't be able to come to Boston. He said Pilkington has been sending him on quite a few "day trips." He had been in Sweden for a day recently, too. (It sounds as though they're keeping him very busy!) He said his family was well. His daughter, Lindsey, had been back in the hospital from Christmas to April, but she was back home and doing O.K.

Rick Bullen, S.M.'82, and his wife Chris had a new baby girl this spring—Georgia Isabell—born on May 29. Sister Valerie (four years old) would have preferred the name Jennifer, but Rick reported she's very excited about her new little sister, even if they did name her Georgia! Rick sounded very happy and relaxed when Jane Morse talked with him by phone in June. . . . In early May **Hank Montrey,** S.M.'82, came to M.I.T. to visit and lecture in Professor **Jim Utterback**'s "Manufacturing/Technology Interface" class. He said Weyerhaeuser had him traveling a tremendous amount these days. There are currently a lot of changes going on at the company, as they are undergoing some reorganization, and Hank had been kept very busy. The students thoroughly enjoyed hearing him in class and getting the chance to grill him more intensely over lunch following.

Jane Morse had a nice little note from **Hakon Myhre,** S.M.'83, in April. He reported Greta and the children were doing very well and that spring had hit Norway already. He wanted to be sure that greetings were passed on to everyone at the program. . . . Some big news about **Bill Vanderslice,** S.M.'83. Bill was remarried while cruising in the islands in April! He and his new wife, Charlene, were happily ensconced in Darien, Conn., in June but were planning to move to Greenwich to a new condominium sometime soon. Charlene also works at IBM, and they met upon Bill's return to the company in summer 1983. Congratulations are in order for them both!—Jane Morse, Program Manager, M.I.T., Room E52-125, Cambridge, MA 02139

XVI

Aeronautics and Astronautics

Edward M. Greitzer, has been promoted to the rank of full professor at M.I.T. effective July 1. Greitzer, a specialist in the fluid mechanics of turbomachines, has been widely honored as a result of collaborations with industry and government research laboratories.

Henry E. "Pete" Clements, S.M.'51, associate director at the National Aeronautics and Space Administration's Johnson Space Center, has been named as the NASA representative to Space Command, responsible for providing a local management interface between all levels of activities at the Johnson Space Center and the Space Command. Clements, a retired Air Force colonel (1971), joined NASA as executive officer in the office of the administrator in Washington, D.C., later joining the Johnson Space Center as technical assistant to the director, where he was in 1981 named associate director. . . . **Thomas P. Collins,** S.M.'73, is currently working toward his law degree, (evenings) at Suffolk Law School, Boston. . . . **David L. Kohlman,** Ph.D.'63, reports, "Now president of Kohlma, Aviation Corp., an aeronautical engineering consulting firm, and Kohlman Systems Research, Inc. (KSR), a flight testing and instrumentation firm. KSR produced the aerodynamic model and data for the Simuflit Learjet Model 35 simulator, the world's first FAA-certified Phase II business jet simulator."

Pao Tan Hsu, Ph.D.'52, of Auburndale, Mass., passed away on April 10, 1981; no further details are available.

XVII

Political Science

The AAPOR Award of the American and World Association for Public Opinion Research was presented post-humously to the late Professor **Ithiel D. Pool** late last spring. Professor Pool, who died on March 11, was cited as a "pioneering theorist and researcher in the fields of public opinion and mass communication (who) combined a life of scholarship with articulate advocacy of human freedom and democratic governance."

XVIII

Mathematics

Professor **George Lusztig** of M.I.T. is the author of *Characters of Reductive Groups Over a Finite Field* (Princeton University Press, 1984), a classification of all (complex) irreducible representations of a reductive group with connected center, over a finite field.

We belatedly record the award of the prestigious 1984 Bocher Prize of the American Mathematical Society to Professor **Richard B. Melrose,** who has been a member of the department at M.I.T. since 1976. Professor Melrose was cited for "his solution of several outstanding problems in diffraction theory and scattering theory and for developing the analytical tools needed for their resolution." A native of Australia, Melrose came to M.I.T. after receiving degrees from the University of Tasmania (1969), the Australian National University (1970), and the University of Cambridge (1974), where he also spent two postdoctoral years.

William Browder, '54, professor of mathematics at Princeton, was chosen last spring for membership in the American Academy of Arts and Sciences, the Cambridge-based honorary society in the sciences and social sciences. Professor **Gian-Carlo Rota** of the department at M.I.T. is the member for mathematical and physical sciences of the academy's Committee on Meetings for 1984-86.

David A. Vogan, Jr., Ph.D.'76, has been promoted to the rank of full professor at M.I.T., effective July 1. Vogan has concentrated his research on representations of semisimple Lie groups; he has added much insight into solving the unitary dual problem.

Robert R. Archer, Ph.D.'52, professor of civil engineering at the University of Massaschusetts, Amherst, and an authority on structural shells, computer stress analysis, and anisotropic elastic anaylsis, has been elected a fellow by the American Society of Mechanical Engineers. . . . **Mark A. Pinsky,** Ph.D.'66, professor of mathematics at Northwestern University, Evanston, Ill., has written *Introduction to Partial Differential Equations with Applications,* published by McGraw-Hill Book Co. . . . **John Rosenthal,** Ph.D.'68, has been promoted to full professor of mathematics at Ithaca College, N.Y. Prior to joining the Ithaca faculty in 1971, Rosenthal was an assistant professor of mathematics at the State University of New York at Stony Brook and also served as associate professor at Michigan State University and visiting lecturer at the University of Sydney, Australia.

XX

Nutrition and Food Science

Alan H. Wayler, Ph.D.'79, assistant professor at the Harvard Medical School and the Harvard School of Dental Medicine, has been named a co-director of Green Mountain at Fox Run Weight Control Communities, Inc. Among Wayler's prior positions, he served as chief of the Nutritional Biochemistry and Metabolism Section of the Veterans Administration Outpatient Clinic, Boston; senior nutrition advisor to the Science and Advanced Technology Laboratory for the U.S. Army Research and Development Command, Natick, Mass.; and research associate and teaching fellow in the department at M.I.T. . . . **Arthur J. Saffin,** Ph.D.'69, reports that he is working as a consultant. . . . **William G. Thilly,** '67, has been promoted to the rank of full professor at M.I.T., effective July 1. Thilly has developed multifaceted research efforts in genetic toxicology and mammalian cell technology; his primary research goal is to reach conclusive evidence as to the causes of genetic changes in humans.

XXI

Humanities

Philip S. Khoury, assistant professor of history at M.I.T., now holds the Class of 1922 Career Development Chair; he's honored for his effective teaching of a number of history subjects related to the rise of Islam and Middle Eastern affairs. Khoury will use the two-year award to prepare teaching materials and launch new research on 20th-century political and socioeconomic change in the Middle East and North Africa.

XXII

Nuclear Engineering

Roger R. Blunt, S.M.'62, a brigadier general, assumed command of the 97th U.S. Army Reserve Command last April at ceremonies at Fort Meade, Md. In his new assignment, General Blunt is responsible for the organization, administration, training proficiency, operational capability, and mobilization readiness of the ARCOM's 110 units in Maryland, Virginia, and Deleware. Blunt will remain in the position of president of Tyroc Construction Co., Tyroc Management Services, and Blunt Enterprises, Inc. . . . **Franklin R. Chang-Diaz,** Ph.D.'77, an astronaut with NASA's Space Shuttle Program, has received the University of Connecticut's Engineering Alumni Award for Distinguished Accomplishments. The only astronaut whose native language is Spanish (from Costa Rica), Chang-Diaz as a child lived with relatives in a small tenament in Hartford, Conn., struggled to learn English, and excelled in high school. He has become "a role model for young Hispanic-Americans and is in great demand as a speaker at schools and universities," according to the *Hartford Courant.*

Technology and Policy Program

Kris Horvath, S.M.'78, has been recently promoted to head of the Marine Planning and Economic Analysis Group for Aramco in Saudi Arabia, where he is responsible for the development of business planning, capital planning, and evaluation of investments related to Aramco's marine operations. . . . **Rick Andrews,** S.M.'80, has accepted a position with Amicon in Lexington, Mass., where he is in charge of market planning.—Richard de Neufville, Chairman, Technology and Policy Program, M.I.T., Room 1-138, Cambridge, MA 02139

ON THURSDAY, SEPTEMBER 13, WANG WILL MEET YOU IN A FAMILIAR SETTING.

M.I.T. and Wang, in cooperation, present a unique opportunity for you to confidentially discuss your career.

On September 13, 1984, Wang's Research and Development Managers will be in the Office of Career Services on the M.I.T. campus to speak with you about Hardware and Software opportunities at all levels in the following technologies:

• Small Systems Development • Distributed Information Systems
• Software Quality Assurance • Performance Analysis • Diagnostics
• Network Operating Systems • Voice Engineering
• Database/Applications Development • Graphics • Network Communication Systems
• Languages & Tools • Operating Systems • Voice/Telephone Software Applications
• Storage & Retrieval Design • High Speed Data Communications
• VLSI Design • TEMPEST Engineering

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To assure your candidacy receives our proper consideration, we encourage you to forward a resume indicating your area(s) of interest to:

Phyllis Jackson, Associate Director for Recruiting
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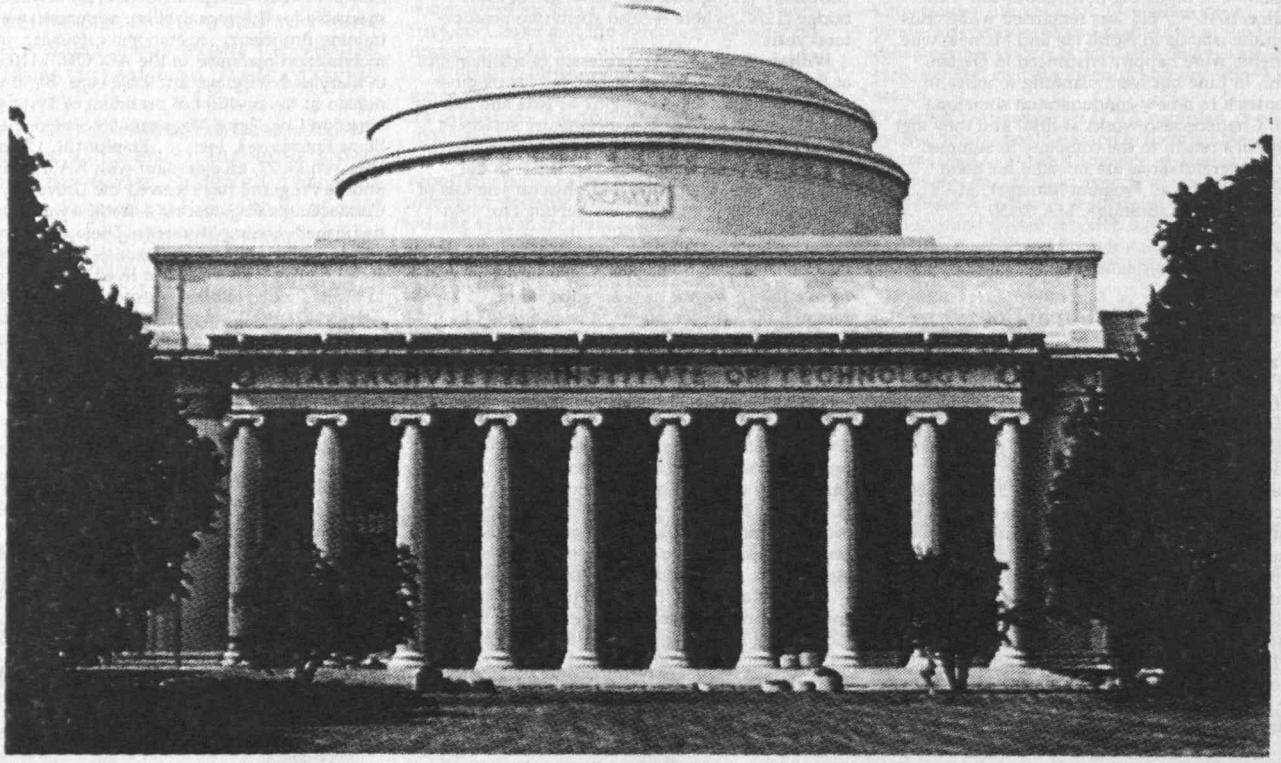
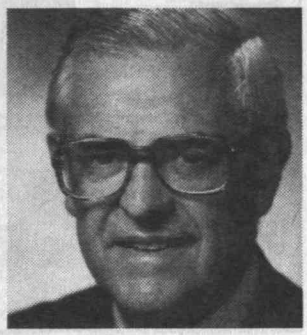
WANG

The Office Automation Computer People.



Obituaries

E. Kirkbride Miller, 1917-1983: Doing Everything He Could for M.I.T.



E. Kirkbride Miller, '41, retired chairman of the board of T.Rowe Price Associates, Inc., who was halfway into his first five-year term as a member of the M.I.T. Corporation, died suddenly in London on June 12; he was 66.

Miller "did virtually all that an alumnus can do for his alma mater," wrote David S. Saxon, '41, chairman of the Corporation; "he maintained a deep sense of gratitude throughout his life for what he felt M.I.T. had done for him."

Miller's interest in M.I.T. never faltered in the more than 35 years since 1937, when he arrived as a freshman. Shortly after graduation from what is now the Sloan School he entered the U.S. Navy and after World War II completed his M.B.A. from Harvard Business School. By 1952 he was an investment counselor at T. Rowe Price Associates, playing a key role in the T. Rowe Price Growth Stock Fund. When Miller stepped down as chairman, the firm was managing more than $15 billion in funds for individuals, foundations, and corporations.

Mr. Miller served in a wide range of capacities for the Alumni Association, receiving the Bronze Beaver in 1981. The National Selection Committee chose him to be president of the association in 1983-84 but ill health forced him to postpone that assignment—and ultimately, therefore, to forego it. Earlier he held leadership positions in the M.I.T. Club of Baltimore, the Class of 1941, the Alumni Fund, and capital fund campaign solicitations. He was at various times a member of the Alumni Association Board of Directors and of the Corporation Investment Committee and visiting committees in economics and civil engineering.

Norman A. Copeland, 1915-1984

Norman A. Copeland, '36, who retired as senior vice-president of E. I. du Pont de Nemours and Co. in 1977, died at his home in Tequesta, Fla., on April 30. He was 68.

As chief engineer and vice-president of Du Pont, Copeland had headed one of the largest private engineering organizations in the world. He studied mechanical engineering at M.I.T. and later chemical engineering at the University of Delaware.

Copeland was a benefactor of the Institute, and he served on the Corporation visiting committee in mechanical engineering for a five-year term from 1968 to 1973.

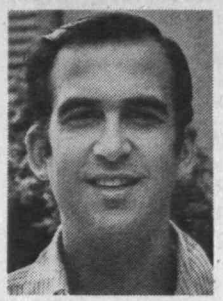
Deceased

Mrs. Carle R. Hayward, '04; January 15, 1983.
Gilbert S. Tower, '05; April 9, 1984; 35 N Main St., Cohasset, Mass.
John A. Holbrook, '10; 1982; 38 West St., Hadley, Mass.
Manuel A. Navarro, '10; May 20, 1954; PO Box 31, Quito, Ecuador.
Cornelius A. Duyser, '12; April 24, 1984; c/o Mr. Harry J. Lapine, 155 Terry Rd., Hartford, Conn.
Alonzo M. Mutersbaugh, '13; November 18, 1983; 912 Clarence St., Lake Charles, La.
Israel H. Lovett, '14; April 7, 1984; PO Box 248, Rolla, Mo.
Frank E. Parsons, '15; 1980.
Benjamin H. Kerstein, '16; 1984; 161 Woodcliff Rd., Newton Highlands, Mass.
Edward Howard Hutchinson, '17; April 30, 1984; 5333 SE Miles Grant Rd., Apt. I-106, Stuart, Fla.
Edward D. Sewall, '17; 1983; Mansion House, Kenwood, Oneida, N.Y.
Mrs. Wirt R. Robinson, '18; 1983; PO Box 11, Exton, Penn.
Huron D. Corthell, '19; 1984; 14 Walnut Ave., Mill Valley, Calif.
Alan B. Miller, '19; 1983; 619 Bow Line Dr., Naples, Fla.
Charles Theron Van Dusen, '20; May 4, 1984; 800 N Ocean Blvd., Delray Beach, Fla.
Mrs. Watts S. Humphrey, '21; 1982; c/o 117 Chandler St. Apt. 3, Boston, Mass.
Stanley L. Scott, '21; March 12, 1984; 5550 Harvest Hill, No. E216, Dallas, Tex.
Homer N. Wallin, '21; March 6, 1984; 900 University St., No. 6L, Seattle, Wash.
Norman L. Apollonio, '22; 1981; PO Box 128, Garden Valley, Calif.
Conrad E. Ronnenberg, '22; March 29, 1984; 1200 Mira Mar, No. 101, Medford, Ore.
Douglas H. Alexander, '23; December 18, 1983; 118 Palmers Hill Rd., Stamford, Conn.
Dale S. Davis, '23; January 30, 1984; PO Box 6, Bailey Island, Me.
William L. Merrill, '23; 1980l 100-30 Ditmars Blvd., E. Elmhurst, N.Y.
Edwin R. Richards, '23; October 23, 1982; Bigelow Apartments 329, Pittsburgh, Penn.
Pierce J. Van Alystne, '23; March 30, 1984; 2833 Junction Highway No. 62, Kerrville, Tex.
Yu Hsiang Woo, '23; 1961; c/o 1017 N Mountain Ave., Tucson, Ariz.
Mrs. Paul J. Cardinal, '24; October 4, 1983; 707 Portside Rd., Naples, Fla.
Robert L. Morton, Jr., '24; 1984; 4466 West Pine Blvd. Apt. 13F, St. Louis, Mo.
Howard B. Stevens, '24; April 17, 1984; 56 Crestview Dr., Bernardsville, N.J.
Jerome J. Taylor, '24; November 10, 1983; 10555 Center, Traverse City, Mich.
Howell C. Rice, '25; January 25, 1983; c/o S. Russian, 24 Muzzey St., Lexington, Mass.
John R. Robertson, '25; May 4, 1984; 7 Pine Tree Ln., Houston, Tex.
Roger Ward, '25; August 1, 1983; 5555 No. Courteney Pkwy., Merritt Island, Fla.
Maurice L. Ash, Jr., '26; May 29, 1984; 162 Maria Ct., Punta Gorda, Fla.
Robert A. Cunningham, '26; January 15, 1984; PO Box 132, RFD 1, Kennedyville, Md.
Edna A. Gerken, '26; 1981.
Merton L. Gilbert, '26; April 18, 1984; PO Box 104, Clio, Miss.
Colin W. Reith, '26; March 18, 1984; 1633 Canyonwood Ct., Walnut Creek, Calif.
Arthur F. Underwood, '26; April 8, 1984; 155 Tree Top Ln., Rochester, Mich.
Joseph L. Fannon, '27; 1978; c/o Richard Fannon, 40 Pond Circle, Jamaica Plain, Mass.
Christian V. Holland, '27; April 11, 1984; c/o C.V. Holland, Jr., 64 Oakwood Ln., Myrtle Beach, S.C.
Rudolf S. Slayter, '28; April 30, 1984; PO Box 462, Lincoln, Mass.
David R. Wiggam, '28; March 29, 1984; 136 East State Rd., West Grove, Penn.
Walter F. Burke, '29; May 1, 1984; 1979 Swallow Ln. West Bluff N., Rancho La Costa, Calif.
Robert W. Gray, Jr., '29; April 27, 1984; 690 Mountain Rd., West Hartford, Conn.
William M. Harris, '29; March 7, 1984; 934 Ybor Ave. W., Venice, Fla.
Franklyn J. Lammers, '29; December 11, 1983; 1450 Concorde Cr., Highland Park, Ill.
Charles Wingate Reed, '29; 1981.
Frederick M. Thomas, '29; 1982; Old Mystic, Conn.
William Dreisel, '30; April 6, 1984; 6 Cornish St. Ext., Methuen, Mass.
John D. Moriaty, '30; March 30, 1984; 120 Schuh Pl., Port Arthur, Tex.
J. Howard Arnold, '31; 1974; 1252 Solano Ave., Albany, Calif.
Elsie Du Pont Elrick, '31; March 24, 1984; 1212 Foulk Rd., Wilmington, Del.
George C. Humphreys, '31; April 12, 1984; 138 Southgate Ln., Southport, Conn.
Daniel P. Johnson, '31; March 21, 1984; 15 Brookview Dr., PO Box 213, Pelham, N.H.
Frederick J. Turner, '31; April 23, 1984; 96 Rockland St., Swampscott, Mass.
James Alan MacDonnell, '32; April 19, 1984; PO Box 36, Rye Beach, Fla.
Henry Arthur Phillips, '32; August 2, 1980; RTE 202 RFD 1, New Hartford, Conn.
Joseph Santoro, '32; June 11, 1984; 47 Hovey St., Watertown, Mass.
Horace Irving Crane, '33; April 8, 1984; PO Box 58, Montgomery, Vt.

Herbert Grundman, '33; April 19, 1984; 10537 113th Ave. N, Largo, Fla.
Benjamin Smilg, '33; November 21, 1983; 40 W 4th St., Suite 2050, Dayton, Ohio.
Wallace W. Cogdill, '34; August 26, 1983; 715 Starboard Dr., Naples, Fla.
Robert D. Faunce, '34; March 2, 1984; 1709 Robindale Rd., Richmond, Va.
Brenan R. Sellers, '34; March 10, 1984; 124 Chandler Dr., c/o E.G. Braver, Jr., West Chester, Penn.
Arthur J. Lariviere, '35; March 7, 1984; 4 Aylesbury Rd., Worcester, Mass.
Arthur L. Merrifield, '35; April 13, 1984; PO Box 15457, Cincinnati, Ohio.
Norman A. Copeland, '36; April 30, 1984; 400 Beach Rd., Tequesta, Fla.
Clarence R. Horton, Jr., '36; June 5, 1984; 28 Bittersweet Trail, Wilton, Conn.
Leonard S. Lang, '36; 1979; c/o University of Pittsburgh, Kas Center, 135 N Bellefield Ave., Pittsburgh, Penn.
Howard Berkey Bishop, Jr., '37; 1984; RFD No. 2 Box 371, Limerick, Me.
Richard S. Mandelkorn, '37; December 2, 1982; PO Box 5002, Santa Fe, N.M.
Mortimer H. Nickerson, '37; April 29, 1984; 112 Willow Ln., Leesburg, Fla.
Robert A. Stanley, '37; March 28, 1984; Green Turtle Cove, 3792 NE Ocean Blvd. Apt. 101, Jensen Beach, Fla.
Frederick G. Schmitt, '38; March 25, 1984; 1396 Outlook Dr., Mountainside, N.J.
Ritchie C. Simmers, '38; April 22, 1984; Flat 4 137 Karori Rd., Karori, Wellington, New Zealand.
Alden P. Bowser, '39; March 24, 1984; 364 Fontainbleau Ter., Los Altos, Calif.
Edward George Pollak, '40; April 5, 1984; PO Box 142, York Harbor, Maine.
Jacob Berezow, '41; March 26, 1984; 1131 University Blvd. W 604, Silver Spring, Md.
Frderick J. Cole, '41; February 25, 1984; 4302 Cole Dr., Pawleys Island, S.C.
Herbert R. Moody, '41; January 28, 1984; 5 Blackwell Pl., Philadelphia, Penn.
Warren W. Yee, '41; April 1984; 3960 Moselle Dr., West Bloomfield, Mich.
David J. Cavanaugh, '42; April 1, 1984; 55 Darroch Rd., Delmar, N.Y.
Elizabeth Sheffield Cross, '44; February 6, 1984; 4 Ridgeline Dr., Kirkwood, Mo.
Edmund R. Jonash, '44; 1982; 1390 Gladys Ave., Cleveland, Ohio.
Donald Joseph Lovell, '45; April 3, 1984; 40 Barton Rd., Stow, Mass.
James W. Speaker, '45; April 10, 1984; 810 Monte Rosa Dr., Menlo Park, Calif.
Celile Berk Butka, '47; March 6, 1984; 372 Central Park West No. 20-J, New York, N.Y.
John A. Hugus, '47; April 22, 1984; 615 Sand Dollar Ln., Watsonville, Calif.
Kevin Lynch, '47; April 25, 1984; 85 Russell Ave., Watertown, Mass.
Daniel A. Lanciani, '48; April 5, 1984; 185 Atlantic Rd., Gloucester, Mass.
Richard R. Sundback, '49; January 9, 1984; PO Box 124, Meadville, Penn.
Michael Dubitzky, '50; 1975; c/o Jadee Management, 210 Riverside Dr., New York, N.Y.
Sylvio R. Pollis, '50; October 24, 1982; R Santa Clara 431/704 BL 1, Copacabana, Rio De Janeiro, Brazil.
Carl G. Blanyer, '54; March 18, 1984; 553 Encino Vista Dr., Thousand Oaks, Calif.
Harvey J. Lander, '55; 1983.
William H. Keating, Jr., '56; January 15, 1983; 121 State St., Framingham, Mass.
John K. Darin, '60; February 28, 1984; 1524 Chat Ct., Naperville, Ill.
Ronald L. Teigen, '62; March 21, 1984; 3210 Fernwood Ave., Ann Arbor, Mich.
David C. Nealon, '70; October 31, 1983; 12 Greensbrook Ave., Belmont, Mass.
David Smith, '70; November 11, 1983; 12 Juniper Ave., Englishtown, N.J.
Randy M. Campbell, '71; November 22, 1982; 2849 Trailwood Dr., Rochester, Mich.
Roy A. Whitehead, '75; June 2, 1984; 626 Main St., Hingham, Mass.

How to Open a Padlock

Puzzle Corner/Allan Gottlieb



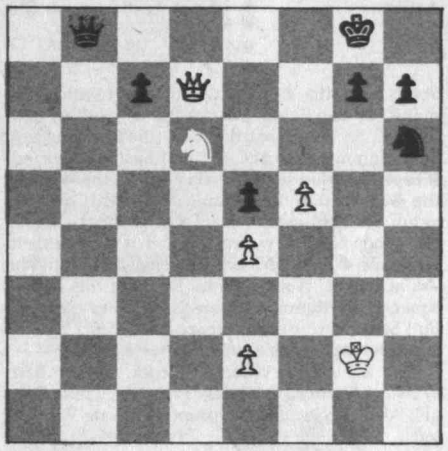
Allan J. Gottlieb, '67, is associate research professor at the Courant Institute of Mathematical Sciences of New York University; he studied mathematics at M.I.T. and Brandeis. Send problems, solutions, and comments to him at the Courant Institute, New York University, 251 Mercer St., New York, N.Y. 10012.

Joseph Horton suggests that I run a new class of puzzle—computer-oriented challenges in which the goal is to compose and run a program to solve a given problem. Mr. Horton further suggests that I specify a particular language and judge solutions on execution time. Since the latter quantity is very machine-dependent, I will permit a class of languages and use the same previously-described subjective criteria to select the solution for publication. To ease typesetting problems, only standard (ascii) characters are permitted; and for readability assembly language is forbidden. I am sorry that APL is ruled out but believe it is necessary. Languages permitted would include Ada, Basic, C, Fortan, Pascal, PL/I, etc. A possible problem in this class would be **APR 2** (*see below*).

As soon as computer-related problems start arriving, I will intersperse them with the monthly chess and bridge offerings. Reader interest will determine their fate. So if you have any such problems, send them in now; the backlog can never be less than it is currently.

Problems

A/S 1. We begin this month with a chess problem (*see next column*) from Bob Kimble (who credits Robert Brieger's *Imagination in the End Game*) that bears a familiar request: "White to move and win."



A/S 2. The following problem is from John Prussing:
An ordinary combination padlock requires three ordered numbers to open, each between 0 and 39, inclusive. Thus there are 64,000 possible combinations. If it is known that the sum of the three numbers is 58 and the sum of the individual digits of all three numbers is 13, how many combinations are possible? If each of these possible combinations is equally likely, what is the probability that the second number is 34?

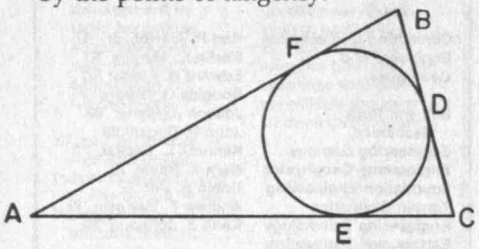
A/S 3. Phelps Meaker has looked at the regular polyhedra and produced the table below. He would like you to fill in the missing entry and wonders if the values in the last column can be determined by a formula. [Of course, there is a fourth-degree polynomial relating these five values to the number of sides, but that is not what is wanted.—*Ed.*]

A/S 4. Matthew Fountain wants you to find infinitely many positive integers n not containing the digit zero such that $n^2 - 1$ contains just two digits neither of which is zero. Note that we are not requiring that $n^2 - 1$ is a two-digit num-

Number of sides	Edges each side	Total edges	Number of dihedrals	Dihedrals meeting at each apex	Number of apices
4	3	12	6	3	4
6	4	24	12	4	6
8	3	24	12	4	6
12	5	60	30	3	20
20	3	60	30	5	?

ber—i.e., the digits may be repeated.

A/S 5. Our last problem is from Harry Zaremba:
Given a triangle ABC, draw its incircle and consider triangle DEF determined by the points of tangency.



Show that the area of DEF is $(r/d)A$, where r is the radius of the incircle, d is the diameter of the circumcircle, and A is the area of ABC.

Speed Department

SD 1. Irving Hopkins wants you to find two functions F and G such that F(n!) = O and G(n!) = 1 for all n≥6.

SD 2. Phelps Meaker asks:
A rectangular pan with perpendicular sides is to be bent up from a sheet of metal 8″ by 10″. Forgetting about tight seams, what is the depth of the pan if it holds 52.5 cu. in.?

Solutions

APR 1. West is defending a six-no-trump contract and has led the ♣A. How can West meet this contract?

	♠ Q 10 3 ♥ Q 7 ♦ A Q J 8 6 4 ♣ J 9	
♠ 9 8 7 ♥ 8 3 ♦ 10 9 7 5 2 ♣ A 10 6		♠ J 6 5 2 ♥ J 10 7 2 ♦ — ♣ Q 8 5 4 2
	♠ A K 4 ♥ A K 9 5 4 ♦ K 3 ♣ K 7 3	

The trick is to break up the threatened squeeze. You either throw it high and tight to a right-hand hitter or lead a low club. John Bobbitt chose the latter. West can defeat the contract, but only by leading the ♣6. A diamond lead could allow South to bring home the entire diamond suit. A heart or spade lead will allow South to successfully squeeze both East and West. Assume a spade is lead (it doesn't matter which). South takes the ♠K and the three top diamonds. East discards two clubs and one spade, South discards a heart. South now takes the three top hearts, and the ♠A. West discards a spade on the third heart, with all other leads following suit. This leads to the following situation:

	♠ Q ♥ — ♦ J 8 ♣ J	
♠ — ♥ — ♦ 10 7 ♣ 10 6		♠ J ♥ J ♦ — ♣ Q 8
	♠ 4 ♥ 9 ♦ — ♣ K 7	

South leads the ♠4. West cannot part with a diamond, or else South will get the ♦J and ♦8 and the ♣K. So West discards a club (the first squeeze). Now dummy leads the ♦J, and East is squeezed. If East discards a heart, South discards the ♣7, and the ♣J is lead to the ♣K and ♥9. If East discards a club, South discards a heart, and South's two clubs are good. Note how important it is for South to retain the ♣K and ♣7 until the end. By leading the ♣6 at trick 2, West deprives South of this double squeeze. Furthermore, there is no other combination South can use to squeeze East-West out of at least one more trick.

Also solved by Woody Pidcock, Robert Bart, Winslow Hartford, Matthew Fountain, Philip Dangel, Alan Berger, and the proposer, Doug Van Patter.

APR 2. In this cryptarithmetic problem—a multiplication problem involving time—each of the 10 digits is to be used once. The first number represents minutes and seconds; the third, hours, minutes, and seconds; and the leftmost digit of each number is nonzero:

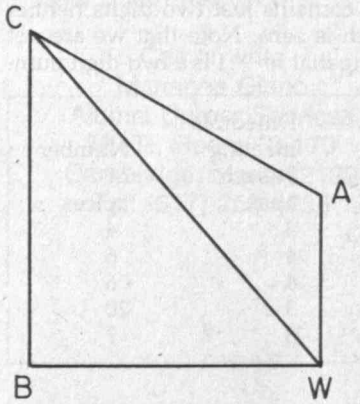
```
  x xx
   xx
------
x xx xx
```

Apparently there are four solutions, as pointed out by Antony Beris:

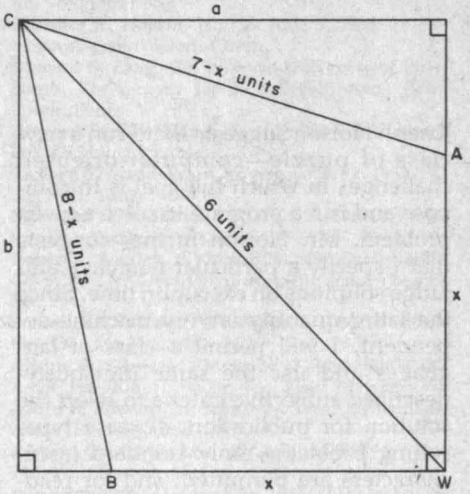
3 02	6 47	4 18	5 09
98	19	72	84
4 57 16	2 08 53	5 09 36	7 12 36

Also solved by Brian Almond, Dennis Sandow, Samuel Levitin, Matthew Fountain, Robert Bart, James Brown, Steven Feldman, and the proposer, Nob. Yoshigahara

APR 3. A commuter lives at C and works at W. He normally drives to work via road CW. Occasionally, to break the monotony of the daily commute, he drives to Town A and from there to W. On still other occasions he drives to Town B and from there to W. Towns A and B are each exactly 10 miles from W and roads BW and AW are at right angles. Our commuter always travels at the same speed, regardless of route. The normal trip takes exactly 30 minutes, the trip through Town A takes 35 minutes, and the trip through Town B takes 40 minutes. At what rate of speed does this commuter travel?



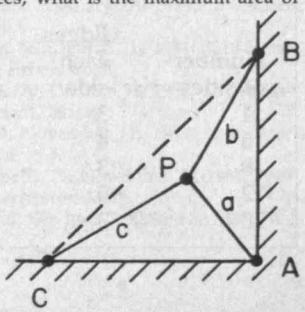
William Veeck, Peter Card, and the proposer, A. Singer, noted that his problem caused quite a flurry of activity when it appeared in *Popular Science*. The following solution is from first-time respondent Woody Pidcock:
The diagram below shows the definition of variables a, b, and x. To keep the magnitude of numbers small, I define x as the time it takes the commuter to travel 10 miles in "5-minute units." The lengths in the figure and the numbers in the following equations represent values in these "time" units.



(1) $a^2 + b^2 = 36$.
(2) $(a - x)^2 + b^2 = (8 - x)^2$.
(3) $a^2 + (b - x)^2 = (7 - x)^2$
Adding (2) and (3), and subtracting (3) from (2),
(4a) $(30 - 2a - 2b)x = 41$.
(4b) $b - a = (30x - 41)/2x$.
(5a) $(2 - 2b - 2a)x = 15$.
(5b) $b - a = (-2x + 15)/2x$.
Adding (4b) and (5b) to solve for b, and subtracting (5b) from (4b) to solve for a,
(6) $a = (16x - 28)/2x$.
(7) $b = (14x - 13)/2x$.
Substituting (6) and (7) into (1) and solving by quadratic formula,
(8) $308x^2 - 1260x + 953 = 0$.
(9a) $x_1 = (1260 + 643.043)/616 = 3.089$.
(9b) $x_2 = (1260 - 643.043)/616 = 1.002$.
From the definition of x above, (9a) results in a rate of speed of 10 miles/(3.089 × 5 minutes) = 38.85 miles/hour. (9b) results in a speed of 10/(1.002 × 5) × 60 = 119.76 miles/hour, which is excessive for daily commuting and quite foolish. Town B would be on the opposite side of town W in a direct commute from town C.

Also solved by Leo Harten (and MACSYMA), Brian Almond, Phelps Meaker, Frank Carbin, Winslow Hartford, Matthew Fountain, Richard Gould, Rhea Graham, Avi Ornstein, John Bobbitt, Norman Wickstrand, Mary Lindenberg, A.C. Lawson, Harry Garber, P.V. Heftler, and the proposer.

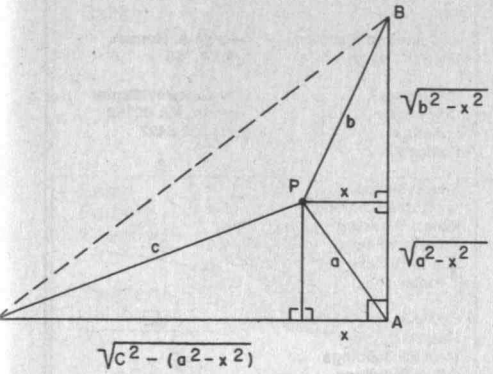
APR 4. In the figure, rigid rods of lengths a, b, and c are hinged at point P, and rod a is hinged to the intersection of the vertical and horizontal surfaces. If the free ends of the rods b and c are always maintained in contact at B and C and permitted to slide along the surfaces, what is the maximum area of



the right triangle CAB that can be formed by the rod extremities? (For uniformity and simplicity, let the constant $K^2 = b^2 + c^2 - a^2$.)

The following is from Harry Garber:

Begin by extending perpendiculars from P to the legs of a right triangle CAB, and let x equal the distance from P to AB. Then the Pythagorean theorem provides the lengths indicated in the sketch.



Then the leg lengths and desired areas for a given x are: $AB = (a^2 - x^2)^{1/2} + (b^2 - x^2)^{1/2}$, $AC = \chi + (c^2 - a^2 + x^2)^{1/2}$. Area = 1/2(AB)(AC).

To maximize the area, find the x which gives $[d(Area)]/dx = 0$. The task is more tractable, I believe, if rather than multiplying the area out and then differentiating, we use the product rule of derivatives:

$$\frac{d(Area)}{dx} = \frac{1}{2}\left[(\overline{AB})\frac{d(\overline{AC})}{dx} + (AC)\frac{d(\overline{AB})}{dx}\right].$$

Since

$$\frac{d(AB)}{dx} = -\frac{x}{(a^2 - x^2)^{1/2}} - \frac{x}{(b^2 - x^2)^{1/2}}$$

and

$$\frac{d(AC)}{dx} = 1 + \frac{x}{(c^2 - a^2 + x^2)^{1/2}},$$

one just multiplies out the result, clearing each term to a separate common denominator, and simplifies to obtain

$$0 = \frac{1}{2}\left[(\overline{AB})(\overline{AC})\frac{1}{(c^2 - a^2 + x^2)^{1/2}} - \frac{x}{(a^2 - x^2)^{1/2}(b^2 - x^2)^{1/2}}\right]$$

Since the area is

$$\frac{1}{2}(\overline{AB}), (\overline{AC}),$$

$$0 = (Area)\left[\frac{1}{(c^2 - a^2 + x^2)^{1/2}} - \frac{x}{(a^2 - x^2)^{1/2}(b^2 - x^2)^{1/2}}\right]$$

and we seek to maximize the area, not minimize it by having it be zero. Thus the rightmost factor is zero, leading to

$$x = \frac{ab}{(b^2 + c^2)}.$$

Plenty of algebra (which I'll omit) follows upon substituting the x back in; I find

$$(\overline{AB}) = \frac{1}{(b^2 + c^2)^{1/2}}(ac + bK),$$

$$(\overline{AC}) = \frac{1}{(b^2 + c^2)^{1/2}}(ab + cK).$$

$$\text{Area} = \frac{1}{2}[bc + aK].$$

Also solved by Harry Garber, Mary Lindenberg, Ben Abunar, A.C. Lawson, Matthew Fountain, Woody Pidcock, and the proposer.

APR 5. The squares of an infinite chessboard are numbered by putting zero in the corner and in each other square putting the smallest non-negative integer that does not appear to its left in the same row or below it in the same column. Find a non-recursive formula for the number placed in row i and column j.

Many readers tripped up here and obtained the incorrect formula i + j − 2. For a two-by-two board this gives

1 2
0 1

instead of

1 0
0 1

However, Matthew Fountain was not fooled and writes:

The number = (i − 1) XOR (j − 1). The XOR operator compares the corresponding digits of two binary numbers and returns a number which contains the digit 1 in those positions where a match is not found and a O in those positions where a match is found. The relationship was found during my construction of the lower left corner of the chessboard. I began by placing the O's, starting with the first row, then the second row, and so on, and noticed that they made a repeating, one-digit pattern up the long diagonal of the chessboard. When I placed the 1's, I noticed the pattern in the first two rows and first two columns was repeated up the long diagonal. After I placed the 2's and 3's, I noticed the pattern in the first four rows and the first four columns repeated up the long diagonal:

7 6 5 4 3 2 1 0
6 7 4 5 2 3 0 1
5 4 7 6 1 0 3 2
4 5 6 7 0 1 2 3
3 2 1 0 7 6 5 4
2 3 0 1 6 7 4 5
1 0 3 2 5 4 7 6
0 1 2 3 4 5 6 7

This suggested renumbering the squares in binary notation.

11 10 01 00
10 11 00 01
01 00 11 10
00 01 10 11

Then it was apparent that every binary number in the square was equal to the result of applying the XOR operation on the number furthest to its left in the same row and furthest below it in the same column. These numbers in turn are equal to one less than the column or row that they are in. Therefore the number at row i, column j is (i − 1) XOR (j − 1).

Also solved by Brian Almond, P.V. Heftler, Woody Pidcock, Robert Bart, and Harry Garber.

Better Late Than Never

NS 2. Angus Lawson sent us a reprint on this problem from the October 1982 issue of the *American Journal of Physics*. Mr. Lawson offers the following explanation for his 1984 response to our 1976 problem:

I worked out the enclosed solution to **NS2** at the same time your excellent column disppeared from my edition of *Technology Review*. Fearing the worst (and being too lazy to check), I published elsewhere, giving you proper credit. Now that I've become a fake alumnus, I have rejoined the ranks of your readers and hope you will enjoy the reprint.

1983 M/J 4. William Veeck found an alternative solution.

N/D 1. Robert Bart found that R−f4 also leads to mate in 3.

1984 F/M 1. Elliott Roberts has responded.

F/M 2. Michael Jung and T. Landale have responded.

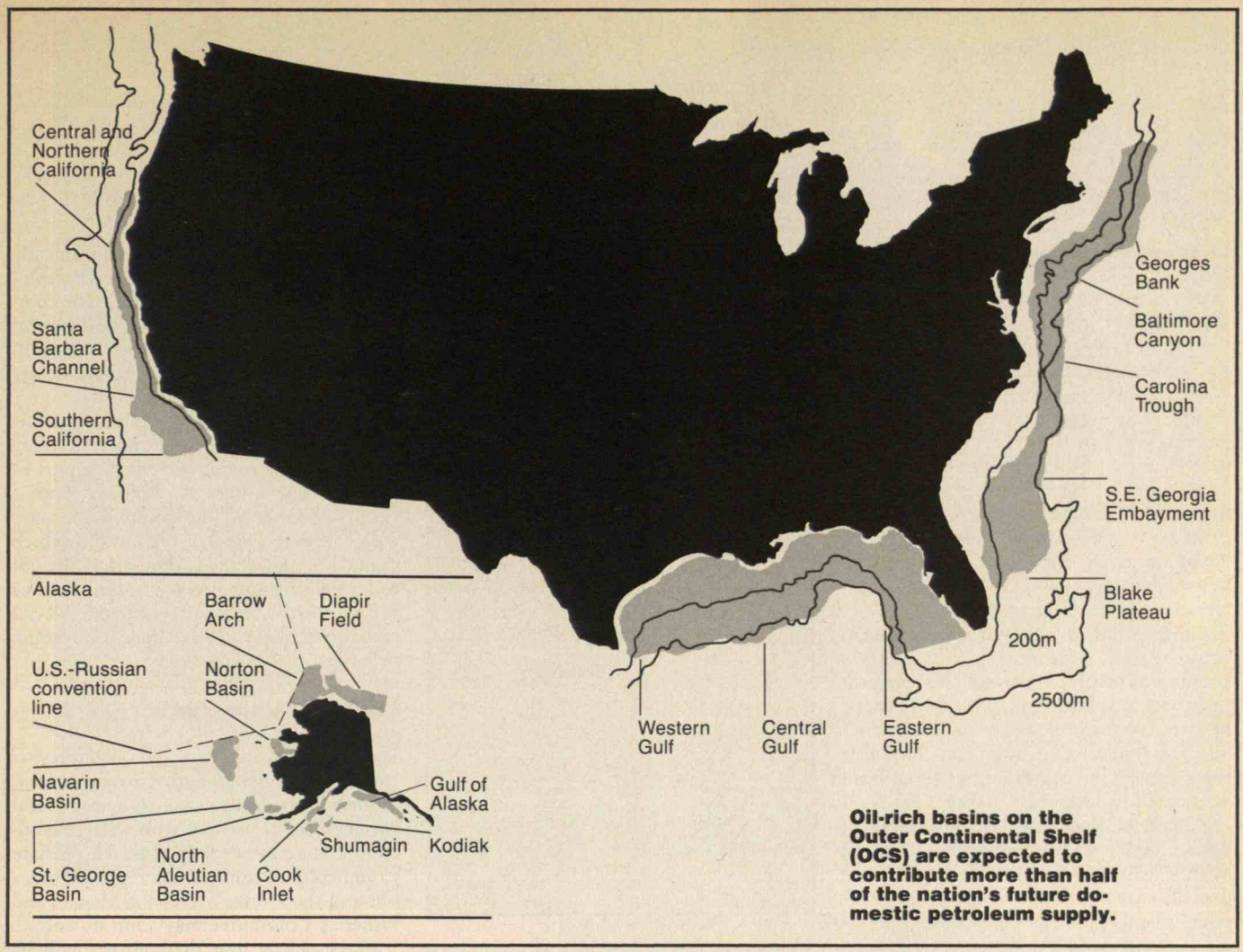
F/M 4. Michael Jung has responded.

APR SD1. Mary Lindenberg and Woody Pidcock noticed that the sequence is n^n.

Proposers' Solutions to Speed Problems

SD 1. sin and cos.

SD 2. 1.5 inches.



Oil-rich basins on the Outer Continental Shelf (OCS) are expected to contribute more than half of the nation's future domestic petroleum supply.

the leasing process," which is the stage when specific tracts within an area are selected for analysis in the draft environmental-impact statement. If a given tract falls short of the "essential tests of potential energy value versus other uses such as fishing or environmental or scenic considerations, then that tract can be dropped from further consideration," Clark says.

He has also agreed to require oil companies to do even more to prevent environmental problems. Interior historically has attached stipulations to the development of leases, requiring companies to take specific protective measures. Clark has extended the use of stipulations to satisfy states' concerns. For example, companies in most cases must build pipelines to move oil ashore—reducing the chance of pollution from tankers. They also must dispose of drilling muds away from fisheries and train employees to avoid conflicts with fishermen.

Clark has revised Watt's five-year leasing schedule as well. To satisfy Alaskans, he indefinitely delayed sale 85, covering tracts in the Barrow Arch geologic region, until more studies can be done on performing oil operations in heavy ice conditions. He slashed the size of sale 92 in the North Aleutian basin by 83 percent and sale 87 in the Diapir field by nearly 50 percent to reduce environmental risks and concentrate exploration in areas with the highest geologic potential. Companies leasing tracts in the Diapir field are also prohibited from drilling or "working downhole" when the ocean isn't frozen to protect Bowhead whales against possible oil spills, and drillers must avoid conflicts with native whaling crews. And sale 88, scheduled for December and offering tracts in the Gulf of Alaska and around Cook Inlet, may be eliminated because of lack of industry interest. Clark even allowed the state, in the recent sale 83 covering the Navarin basin, to decide if the plans devised by oil companies for handling oil spills, as well as for transporting, unloading, and storing crude oil, were adequate—something his predecessor never would have considered.

Clark recently rescheduled controversial sales off southern California and in the Georges Bank region off Massachusetts. Those sales, set for last January but postponed when officials in both states objected, will take place this fall. However, he has dropped all tracts within regions covered by the congressional moratoria—leaving less than 60 percent of the original acreage studied in the North Atlantic and 34 percent off southern California. And environmental stipulations for the two sales are tougher than ever. In the California sale, for example, companies must not only pipe crude oil to shore; their leases will also be subject to federal air-quality rules not yet issued.

Development—but When?

If you view the OCS leasing process as a battle between the oil industry and environmentalists, Clark has judically taken the middle ground. He has readily made concessions to environmentalists but remains an advocate of offshore exploration. "The OCS is an extremely important source of energy and is expected to remain so well into the next century," Clark says. "At the end of 1983, America's offshore region contributed about 10.8 percent of total domestic oil production and 23.7 percent of natural-gas production. The OCS is predicted by many to contain over half of our future domestic petroleum production." He claims the leasing moratoria have already resulted in the loss or deferment of production of about 328 million

MAP: OMNIGRAPHICS

Oil companies are seeing their exploratory wings clipped as they are denied access to federal waters.

barrels of oil, a loss of $44 million in interest on lease bonuses, and other economic losses, including job opportunities, totaling $111 million.

California Governor George Deukmejian agrees, and has recommended that the congressional moratoria covering OCS leasing off his state be lifted. "The oil and gas resources of the OCS are too important to national security and to the economy to be tied up in blanket moratoria," he says. He adds that through Clark's approach, "I believe future sales will be focused on areas with high potential and reasonable risk and that California's interests will be well protected."

Others want to wait and see. Representative Panetta maintains that Clark's promise to involve state and local governments is as yet unfulfilled. "On the basis of actual changes in the leasing program," he says, "one simply cannot conclude that the concerns of coastal states have been adequately addressed." Sarah Chasis of the Natural Resources Defense Council calls Clark's commitment to changing Watt's leasing program "uncertain," especially since Clark still supports area-wide leasing. And the Environmental Policy Institute issued a statement stressing that congressional protection of certain areas "has been justified and will continue to be necessary until a more rational and fair program" is in place. "There is no doubt that our offshore reserves need to be developed in an orderly fashion," the institute says. "However, the nation will not be harmed over the long run if sensitive areas of our coastal waters are held back from leasing for the present."

In the latest round between the states and the federal government, the government won. In January, the U.S. Supreme Court ruled that Interior does not have to mesh offshore leasing with state coastal-zone management plans. The federal Coastal Zone Management Act (CZMA) requires federal agencies to conduct their coastal activities in a manner consistent with state planning programs. Based on the CZMA, California sued to block a 1981 sale of OCS tracts totaling 770,000 acres off San Luis Obispo. The state claimed that offshore leasing should be consistent with state programs because leases lead to oil and gas development that affects the state's coast.

California won in the trial and appellate courts, and Interior was prohibited from opening oil companies' sealed bids. But the Supreme Court reversed the decision by a vote of 5 to 4. The court said that federal law does not require Interior's activities in the OCS to be consistent with state management plans, and that lease sales—in themselves—don't directly affect coastal zones because oil companies must obtain further permits before drilling.

Future offshore lease sales	Scheduled for
1984	
Diapir Field (Alaska)	August
North Atlantic	September
Southern California	October
Gulf of Alaska/Cook Inlet	December
1985	
South Atlantic	March
St. George Basin (Alaska)	April
Central Gulf of Mexico	May
North Aleutian Basin (Alaska)	August
Western Gulf of Mexico	August
Mid-Atlantic	October
Eastern Gulf of Mexico	November
Norton Basin (Alaska)	December
1986	
Navarin Basin (Alaska)	March
Central Gulf of Mexico	April
Western Gulf of Mexico	July
Diapir Field (Alaska)	August
North Atlantic	September
Southern California	October
Kodiak (Alaska)	October
1987	
South Atlantic	January
Barrow Arch (Alaska)	February
Central and Northern California	On hold
St. George Basin (Alaska)	April
Central Gulf of Mexico	April
Shumagin (Alaska)	June

Secretary Clark has not yet invoked the court's decision—though he could—as a shield for Interior's leasing plan. Instead, he has tried to negotiate agreements with leasing opponents. "While the Supreme Court has ruled that no formal federal consistency determination is required at the lease sale stage," he says, "we nevertheless agree with the court that early consultation on coastal-zone management issues is a wise course of action."

However, the legal wrangling has taken its toll on the oil companies who eventually won the California leases. No company has yet filed exploration plans. Indeed, companies have relinquished 12 of 19 tracts for which they paid lease deposits totaling $19 million. Atlantic Richfield Co. (ARCO), which gave up 7 tracts, issued a statement that "the passage of three years of litigation caused the company to readjust its exploration plans. Our re-evaluation now indicates that these tracts of land are less attractive economically than other projects to which our exploration funds are being directed." The company added that "the environmental climate remains unsettled with a reasonable certainty of continued costly delays and burdensome restrictions."

The California Coastal Commission has promised to fight any attempts to explore or develop the tracts, which are a part of the sea otter's habitat. William Travis, deputy director of the commission, says that "although we lost the lawsuit which would have given the commission the right to review offshore leases . . . ultimately we get to review them anyway and ARCO recognized the fact that they were going to have a real hurdle later on."

Legislative Maneuvering

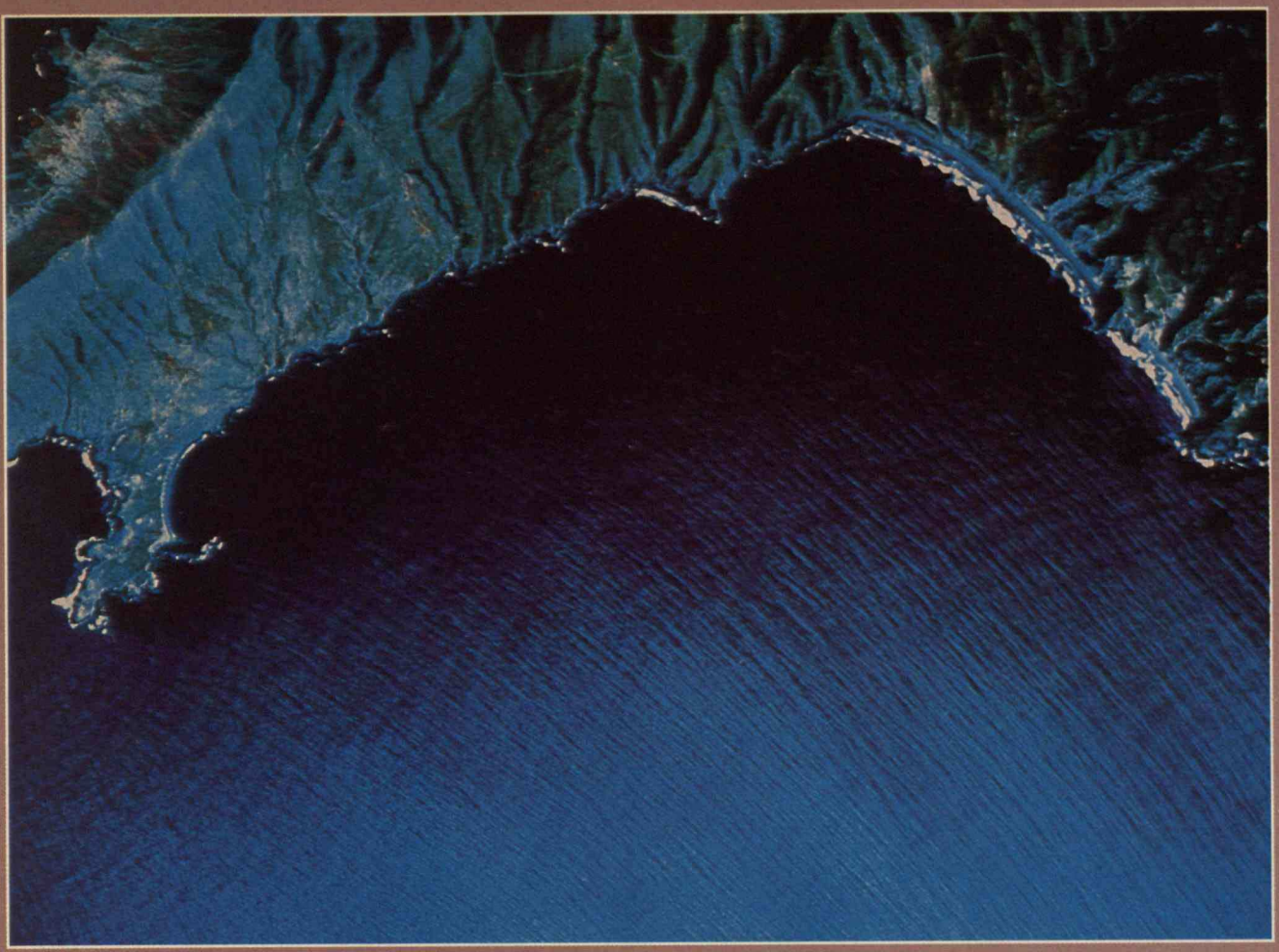
Led by antileasing legislators, Congress is considering legislation to "correct" the Supreme Court decision and require federal leasing to be consistent with state coastal-zone management programs. The Senate Commerce Committee has reported out a bill and the House Merchant Marine and Fisheries Committee may soon do so.

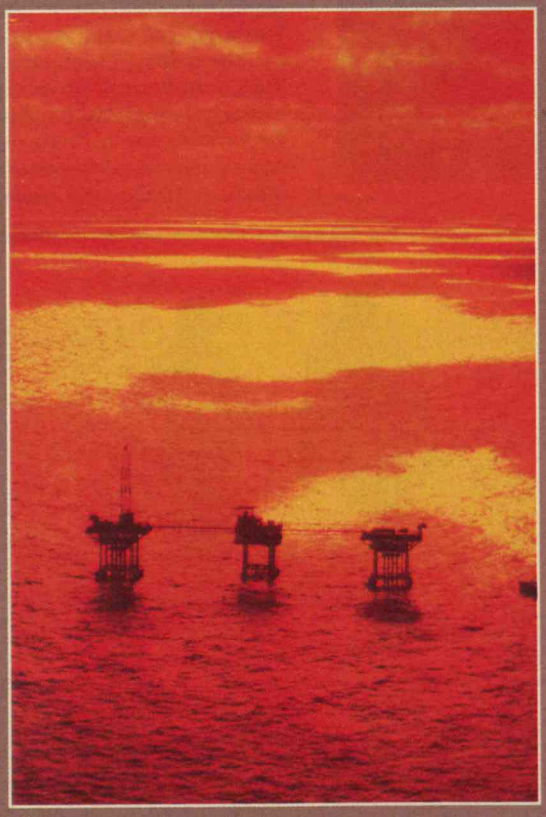
Clark warns that their efforts will be futile. "In its present form, duty would require that I recommend the president veto the legislation. We are doing nothing at Interior that is inconsistent with state programs. The proposed legislation is far reaching and affects far more than offshore leasing." For instance, he says the entry of a navy destroyer into a coastal port could be judged a federal activity affecting the coastal economy and thus require state permission.

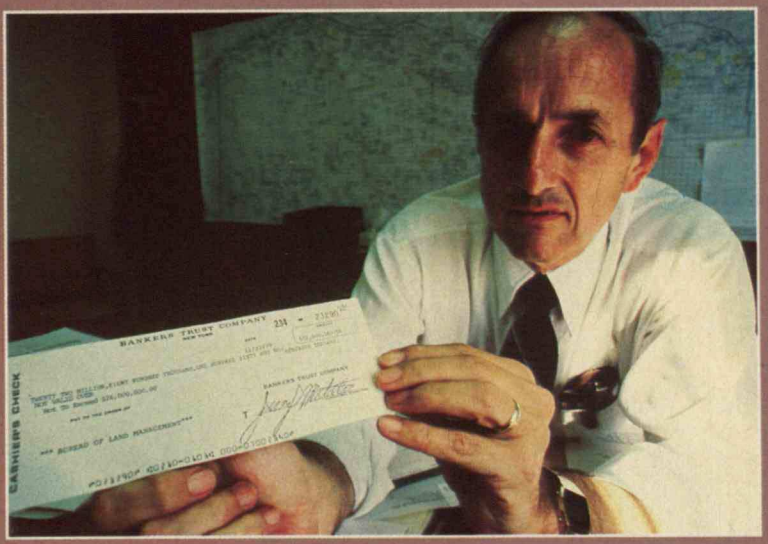
He adds that in addition to giving state interests precedence over the national interest, a tighter consistency requirement would complicate matters where several states are involved. "Although a majority of the states may find a proposed sale to be consistent with their individual coastal-zone management programs, any one state's nonconcurrence could delay or prohibit the leasing," he says. "We have already had instances where states have disagreed." Clark has urged Congress to stay legislation until the results of his increased cooperation with coastal states become evident.

However, the Coastal States Organization (CSO), representing 30 coastal and Great Lakes states and five territories, says

Continued on page 47







The Point Arguello field in California's Santa Barbara Channel, photographed by satellite, is one of the oil industry's most promising new areas (top). Such major discoveries are needed to help supply the 32 billion barrels of oil the nation will consume over the next 10 years. The Gulf of Mexico will remain a robust producer for several more decades, but its reserves will slowly dwindle (left). Offshore leasing provides more than just oil—it sends more money into the federal coffer than any source except income taxes. This executive hands over more than $22 million during a lease sale in New Orleans.

PHOTOS: AMERICAN PETROLEUM INSTITUTE; TENNECO INC.; FLUOR

Oil on Ice

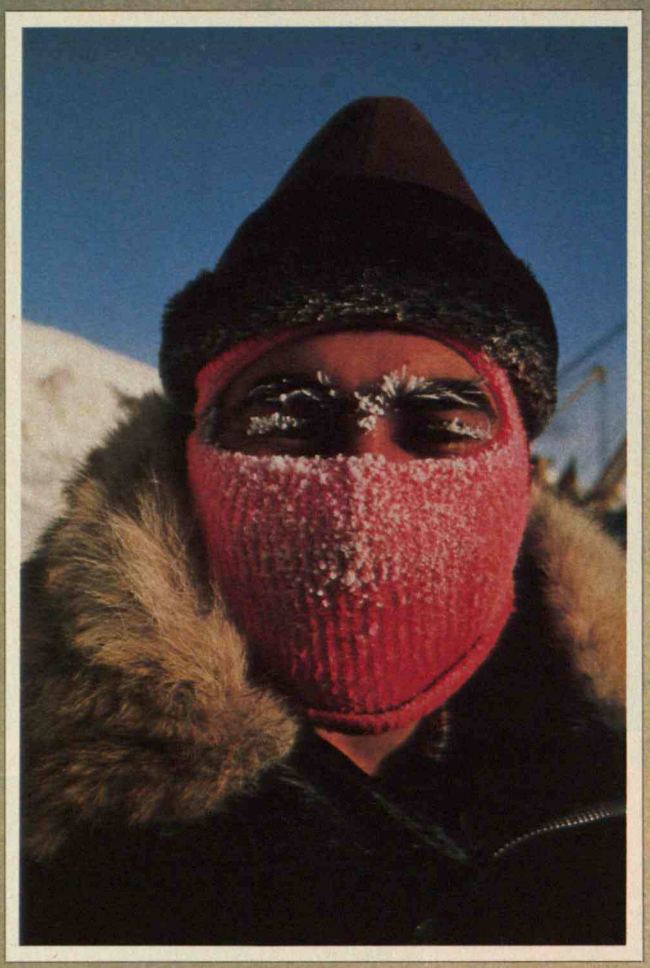
BY RANDALL JOHNSON

DAWN breaks late over Alaska's Beaufort Sea in mid-October. Even at 10 o'clock, the dazzling pinks and purples of the Arctic sunrise barely yield to daylight. Occasional black veins of open water streak through the newly formed ice.

On this particular morning, a related but far different scene is shaping up in Anchorage, 700 miles to the south. There 1,200 people have squeezed into a converted banquet hall for a long-awaited event.

"Good morning ladies and gentlemen," says Esther Wunnicke of the U.S. Minerals Management Service, "and greetings from the Department of the Interior." For the next several hours, she will hold the audience spellbound merely by reading numbers and company names.

The occasion: the most recent federal lease sale of tracts on the Outer Continental Shelf (OCS) in the Beaufort Sea. The tracts are part of the Diapir field, located some 40 miles off the coast and slightly west of the giant Prudhoe Bay oil and gas field discovered onshore in 1968.



The U.S. Geological Survey calls Diapir field one of the nation's largest known potential hydrocarbon deposits, containing as much as 2.4 billion barrels of oil and 1.8 trillion cubic feet of gas. By comparison, a "good" field in the Gulf of Mexico holds 100 million barrels of oil.

By the time Wunnicke opens all the sealed bids, according to *Exxon USA* magazine, 23 oil companies have leased nearly half of the tracts. They immediately pay a total of $2.1 billion—20 percent of the lease price per tract—to the U.S. Treasury.

Fighting Ice

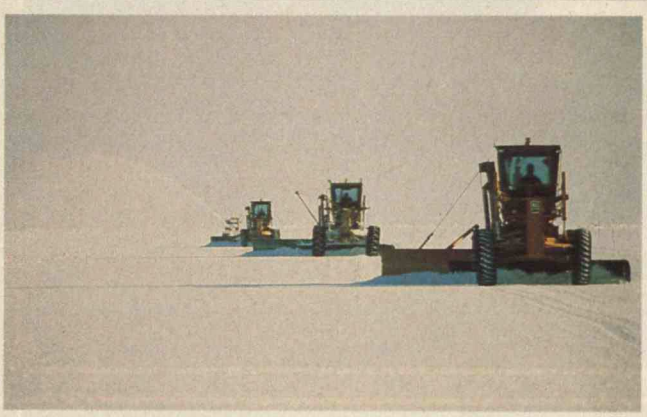
If Alaska's OCS offers abundant promise, working there also presents a host of obstacles. Temperatures plunge to -35°F for weeks at a time. Earthquakes are an ever-present possibility in some areas; high winds and powerful waves pose hazards in others. Exploration crews sometimes carry powerful rifles—known locally as "polar-bear protec-

tion devices." But according to Albert Swank of Veco, Inc., an Anchorage construction company, "Everybody is really fighting one thing—ice." Ice in the Beaufort Sea typically freezes to a thickness of 6 feet or more for up to 10 months of the year.

"Sea ice is the most dynamic solid on the surface of the earth," says William Campbell of the University of Puget Sound. Ice crushing against an offshore structure exerts a pressure of 60,000 pounds per square foot. By contrast, winds typically exert only about 40 pounds per square foot and waves up to 3,000.

These forces, together with the remoteness of the area and the sensitivity of the Arctic environment, have "dictated conservative structural designs" for oil rigs, according to engineers at Brown & Root, a prominent offshore-engineering company. "In fact, most of the Arctic 'structures' built thus far are simply artificial islands in shallow water."

About 30 such islands have popped up off Alaska and Canada since the mid-1970s. Mukluk, built by Exxon, is the biggest and most expensive—standing 60 feet tall, measuring 350 feet across at the surface and twice that at the seabed, and costing roughly $140 million.



Finding oil under the icy Beaufort Sea off Alaska's north coast tests both humans and machines. Wells are often drilled from artificial islands, such as Gulf Oil's Cross Island (above, top). Below, surveyors lay out the location. Workers then haul in tons of gravel from shore over groomed "ice roads" (above). The largest island so far cost $140 million—and the well was dry.

However, Exxon announced late last year that drilling had turned up water, not oil. Mukluk became the highest-priced dry hole ever, and the echo reverberated all the way to Wall Street. But one company official remarked, "There's still more to be done up there. This isn't the whole story." And *Oil & Gas Journal* notes that "explorationists still consider the Beaufort Sea one of North America's most prospective petroleum provinces."

Most artificial islands are made of gravel—1.2 million cubic yards worth in the case of Mukluk—and are built during winter when "ice roads" can be made to provide access to the site. Workers truck in load after load from gravel pits on land, dumping the gravel through a hole hacked in the ice. The gravel steadily accumulates to

PHOTOS: STEVE MCCUTCHEN, ALASKAPHOTO; GULF OIL COURTESY OF AMERICAN PETROLEUM INSTITUTE

form a stable platform for the drilling rigs.

Some oil companies are adding a new technological wrinkle. They place caissons, huge concrete or steel retainers, on the seafloor to hold the gravel. The caissons slow the erosion that ordinarily eats away at artificial islands. They also reduce significantly the amount of gravel needed, cutting costs and saving precious construction time. When drilling is complete, the caissons are moved to the next job.

Explorers on the Move

However, companies want even more mobility for exploration. They often use "weatherized" drillships protected by icebreakers. But since such ships are restricted to the short Arctic summer, companies are scrambling to develop self-contained mobile drilling units that can stand up to the Beaufort's icy grip.

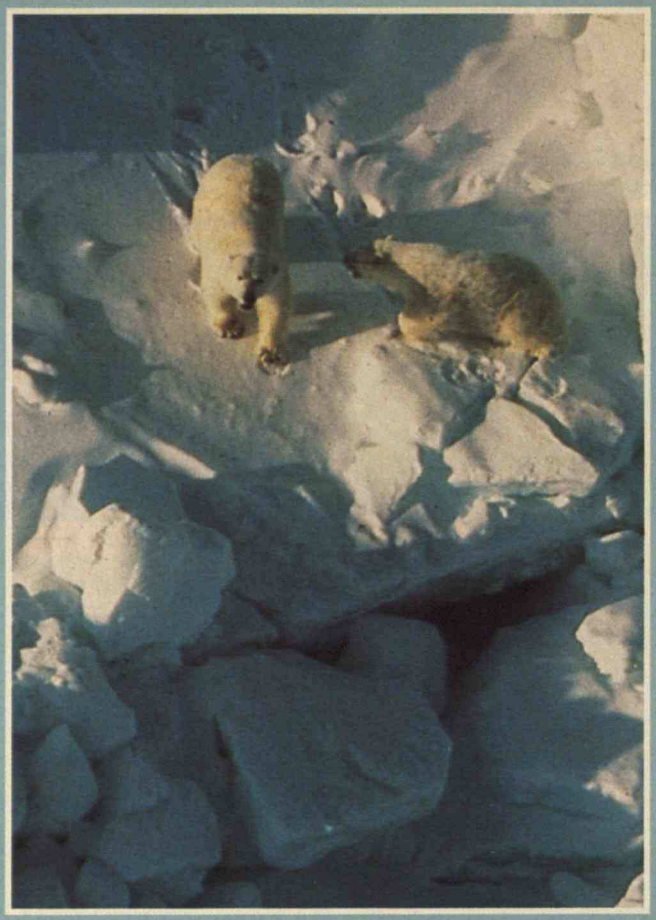
For example, the Kulluk completed its first drilling season off Canada last December, performing well in the face of severe ice conditions. The 29,000-ton unit floats on the surface; cables anchored to the seabed hold it in place. Kulluk's conical shape forces sea ice to slide harmlessly up the rig's sides and bend back on itself. The rig can operate in ice four-feet thick, and is designed for a 200-day drilling season.

Another mobile rig, Molikpaq, will arrive soon, towed from its construction yard in Japan. The submersible rig will hunker on the seabed, ballasted securely with water and sand. Rising above the surface, its 300-foot-square deck will hold not only drilling equipment but supplies to last six months. Molikpaq can drill year-round.

The Concrete Island Drilling System (CIDS) will also debut during this August's "weather window." The CIDS consists of honeycombed modules, called bricks, that can be stacked on top of one another, along with a barge-mounted drilling rig that perches on top of the bricks. Every component floats, and the entire CIDS can be deballasted and moved to a new location within 48 hours. The CIDS can drill in depths up to about 70 feet, and Global Marine Development, Inc., is modifying the system to handle waters up to 150 feet deep.

While OCS activity has been busiest in the Beaufort Sea, vast oil-bearing basins in the Bering Sea off western Alaska are also opening up to exploration. The Bering, though hardly gentle, doesn't play quite so rough. Thus, wildcatters will often be able to use conventional drilling rigs, usually beefed up for extra strength. Indeed, the offshore-construction industry is already announcing a new generation of harsh-weather "jackups" and semisubmersible exploratory rigs.

"The concepts we're looking at for drilling in OCS waters off Alaska represent a significant departure from the past, in both the uniqueness of their design and the magnitude of their cost," says C.D. Roxburgh, Exxon's vice-president for production. Of course, risk is nothing new in the oil business. Still, the Arctic is formidable. And it's probably wise to remember the counsel on risk taking once given by British statesman David Lloyd George. "Don't be afraid to take a big step if one is indicated," he said. "You can't cross a chasm in two small jumps." □



Ice in the Beaufort Sea freezes more than 6 feet thick and lasts most of the year. Thus, workers need huge saws to open holes for pouring in the gravel that forms a drilling island (left). But ice isn't the only worry. Polar bears cast a leery eye at a commuting helicopter (top). And wind-driven snow can make getting started in the morning a chore (above).

RANDALL JOHNSON is an ocean engineer and writer in Houston, Tex.

the legislation wouldn't give states veto power over federal activities, but would provide them with the muscle they need to help resolve conflicts. The organization argues that "the coastal states' record of achievement and ability to responsibly manage the coastal resources of the United States in a spirit of cooperation with the federal government runs contrary to the Supreme Court's ruling." And it points to a recent survey by the National Oceanic and Atmospheric Administration that revealed that, of all federal activities reviewed by coastal states for consistency with their coastal-zone management plans, the states denied only 2 to 3 percent.

California Attorney General John Van de Kamp argues that without a consistency bill, states are powerless to stop leasing. And if they can't stop leasing, they can't stop exploratory drilling and development. "Only at the lease sale stage," he says, "can Interior insert the extra stipulations necessary to protect biological resources or air quality, and thus bring consistency." After the sale, Van de Kamp says, "the train is on the tracks. The law of inertia applies. It's very hard to stop drilling operations once the lease is issued, and almost none have been stopped."

While the fate of antileasing legislation is being debated, Congress is likely to pass a separate bill this session giving coastal states a share of federal OCS royalties. The states now receive no revenues from federal tracts, unless wells on those tracts drain oilfields that also underlie state waters. There is no direct link in Congress between the consistency and revenue-sharing bills, but many observers think that giving states a share in OCS revenues will dilute their opposition to leasing. However, the Reagan administration—with one eye on the budget deficit—staunchly opposes the bill, as it would lower the amount of cash flowing into the U.S. Treasury. Clark has tried but failed to reverse that stance in meetings with budget officials, a cabinet council, and in mid-June with the president himself.

Despite a likely presidential veto for the revenue-sharing bill, the congressional skids are greased for passage. The House has approved a bill that several senators plan to offer as an amendment to a Senate bill, yet unknown, that the president is likely to sign. The bill would give the states up to $300 million of OCS revenues. All coastal states, including the Great Lakes states and U.S. territories, would be eligible even though they may not have offshore oil production. The money would be allocated based on a formula that takes into account factors such as miles of shoreline, coastal population, and energy facilities on the coast. Louisiana and Alaska would receive the most money, about $40 million per year, with California and Florida receiving about half that much.

American oil companies drilling offshore now face a political risk they never thought they would confront at home.

Political Hide-and-Seek

The offshore drilling debate has left oil companies confused and frustrated. Despite the current temporary surplus of oil and gas, the need for additional production from the OCS in the future appears certain. For example, the American Petroleum Institute notes that the United States will have to find 32 billion barrels of crude oil over the next 10 years just to replace the domestic oil consumed during that period. That volume of oil is more than the nation's proven reserves. Oil industry officials maintain that because long lead times are required for oil and gas development—5 to 10 years from the lease sale to the startup of production—opposition to current sales shouldn't be based on today's surplus.

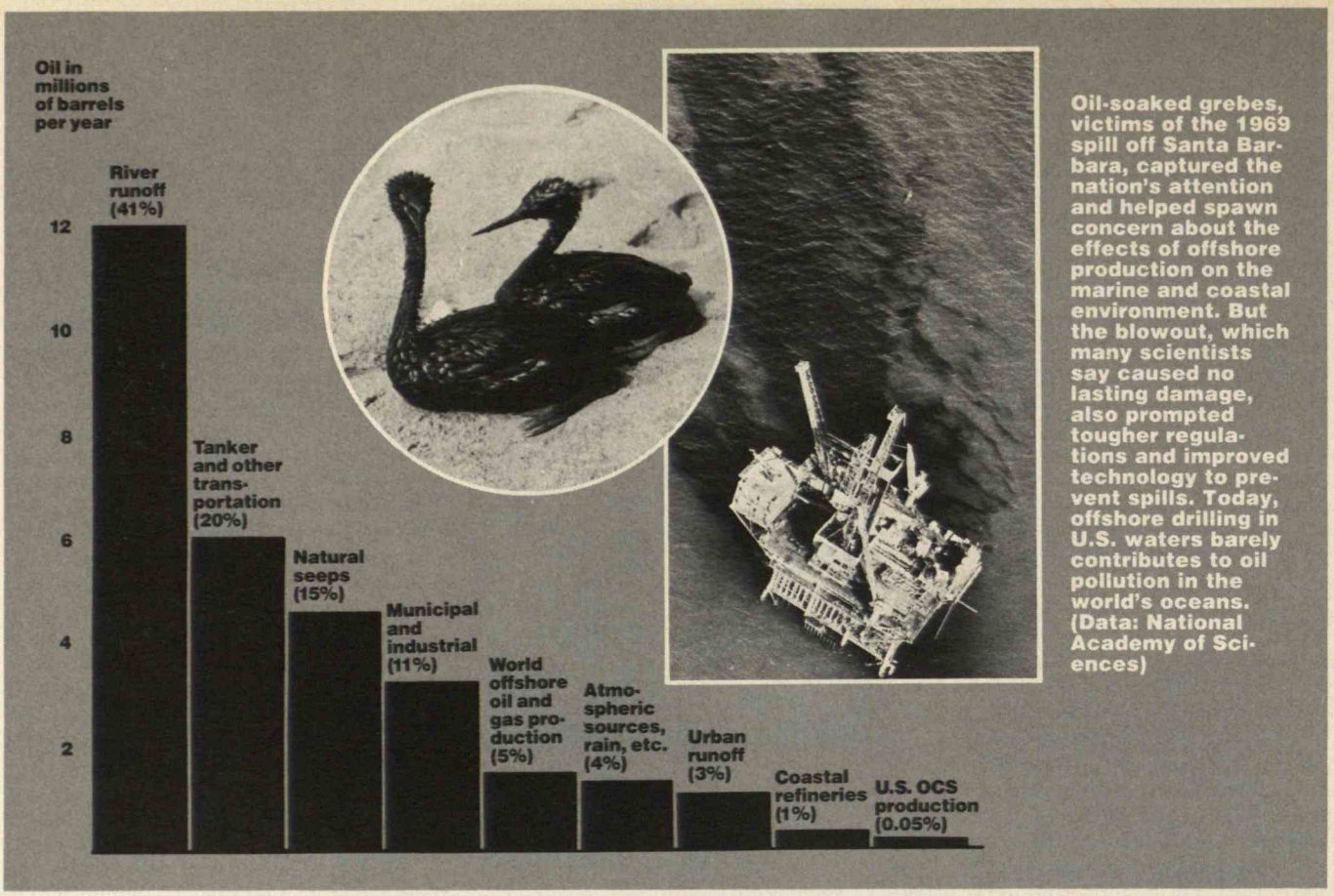
William E. Crain, an exploration manager for Chevron U.S.A., Inc., complains that congressional bans on funding for lease sales cover "almost all of the inner basins off southern California. These inner basins are right next to onshore fields that contained almost 6 billion barrels of oil, most of which has already been produced. The basins could produce 2 billion barrels or more of oil, according to U.S. Geological Survey estimates."

He adds that leasing has been banned in at least five sedimentary basins off northern California as well. "Four of these basins span one geologic formation, known as the Monterey, that has produced 1 billion barrels onshore but remains untested offshore," he says. "Geological Survey estimates indicate that these basins might yield 4 billion barrels or more of oil. But they are off limits to our industry's exploration teams."

James Henry, ARCO Exploration Co.'s vice-president for finance and planning, says that "much of our investment off the California coast for geological and geophysical data has been essentially wasted, and the opportunity for making an important addition to the nation's petroleum reserves has been cut off. Our efforts should be expended to find oil and gas, not wasted in a fruitless game of political hide-and-seek." ARCO has spent $60 million on geophysical studies off California and the industry as a whole has probably spent half a billion. Henry adds that ARCO has invested $15 million to study the Bristol Bay area off Alaska since 1970 and still is waiting for a lease sale. "If our competitors up there have each spent half as much," he says, "we are looking at presale investments in excess of $100 million for just one offshore area."

The oil industry can't understand environmentalists' opposition. Many executives cite a report by the Interior Department that concludes: "The 1969 Santa Barbara blowout is the only occurrence in the course of drilling some 30,000 U.S. offshore wells that resulted in significant oil reaching shore. According to marine scientists, it caused no lasting damage. More importantly, following that spill the Interior Department implemented tough new regulations, requiring subsea blowout

PHOTO: PHOTO RESEARCHERS



Oil-soaked grebes, victims of the 1969 spill off Santa Barbara, captured the nation's attention and helped spawn concern about the effects of offshore production on the marine and coastal environment. But the blowout, which many scientists say caused no lasting damage, also prompted tougher regulations and improved technology to prevent spills. Today, offshore drilling in U.S. waters barely contributes to oil pollution in the world's oceans. (Data: National Academy of Sciences)

preventers, oil-spill contingency plans, and more inspections. Together with improved worker training programs and special stipulations on many leases, these changes make a serious blowout or other major spill highly unlikely today.

"In fact," the report continues, "since those controls were instituted in 1970, America has produced more than 4 billion barrels of oil from federal waters—while losing a total of only 791 barrels as a result of blowouts . . . . By comparison, natural oil seeps in the Coal Oil Point area off Santa Barbara alone discharge 22,000 to 36,000 barrels of oil every year."

The growing resistance of states to OCS leasing is especially ironic given their record. "The actions of some coastal states regarding offshore leasing in their own waters speak volumes about the general safety of offshore oil and gas exploration and production," says William Bettenberg, director of Interior's Minerals Management Service. "For example, of the roughly 4,000 wells drilled off the California coast, nearly 3,300 have been in state waters under leases and permits issued by the state. From 1975 to 1982, while some vigorously protested drilling in federal waters off the California coast, the state issued nearly 600 drilling permits in state waters much closer to shore."

In 1983, exploration of the OCS dropped to about 54 percent of what it had been two years earlier, a reflection of both leasing problems and decreasing oil and natural-gas prices. But despite the political risk, exploration is expected to pick up. California's potential remains high. In the Santa Maria basin, oil companies have opened the Point Arguello field, the only major discovery in a "frontier area" in recent years. It has 1 to 3 billion barrels of reserves and will begin producing up to 100,000 barrels of crude daily during the next two years. The industry is less enthusiastic about prospects for the Atlantic OCS after 45 consecutive dry holes, but some companies are still drilling.

Drilling in the Gulf of Mexico remains fairly stable, with the most excitement centering on prospects for moving into deeper waters. For example, Getty Oil Co. plans a six-hole exploration program in 1,700 to 2,000 feet of water on Viosca Knoll off Louisiana. Diamond Shamrock Exploration Co. plans a 10-hole program in the 600-foot-deep Garden Banks area. And Exxon recently announced the discovery of a large field in 1,400 feet of water in the Mississippi Canyon area, about 60 miles off Louisiana, which the company believes may contain more than 100 million barrels of oil.

However, the hot spot in future OCS exploration will be Alaska, where oil companies plan to drill a number of $30 million wildcat wells in the next two years. The Alaska Oil & Gas Association says the state's oil and gas potential is probably greater than any other region in North America. "The state represents 74 percent of the total area of U.S. offshore lands and much has good hydrocarbon potential," the association maintains. "The favorable geology of Prudhoe Bay on the North Slope continues northward into the Beaufort Sea, and this is why the Diapir field in the Beaufort has received so much attention from oil explorers. It has the potential, as do other sedimentary basins on the Alaska OCS, of containing giant oil fields."

The remainder of this session of Congress could be critical for the OCS leasing program. It is sure to show whether Secretary Clark's conciliatory overtures to coastal states and environmentalists are working. The controversy could ease—if Congress does not add to the drilling bans, if it does not pass a consistency law, and if the administration relents on an OCS revenue-sharing bill. However, the Seaweed Rebellion is certain to boil again next year, when Interior sends another five-year sale plan to Congress for review.

PATRICK LAWRENCE, a free-lance writer in Washington, D.C., has covered energy issues for 10 years.

This is the second of a two-part series on offshore oil. Part one ran in the July issue.

PHOTOS: SANTA BARBARA NEWS-PRESS

PEOPLE ARE TALKING ABOUT U.S.

People all over the world are talking about people in the USA. Correspondents in Tokyo. Commentators in Bonn. Reporters in London. Journalists in Bogata. And what they're saying about us is enlightening, alarming, provocative and important.

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The Politics of Starvation

Continued from page 27

Small-Scale Projects That Work

International agencies have identified a package of activities that could be effective in improving local food production and preventing malnutrition on a case-by-case basis. Agricultural research and extension programs, for instance, often work on a community level even with little government support. For example, extension workers from the United States and other developed countries have helped boost food production in many areas by introducing new varieties of wheat, corn, and rice as well as more effective cultivation practices. Countries as diverse as the Philippines, Vietnam, China, India, Bangladesh, Pakistan, Mexico, and Egypt have benefited from this type of aid.

WHO and UNICEF have pinpointed some health measures that are also effective on a limited basis. For instance, growth charts and regular "weigh-ins" can help identify infants who are not being adequately fed. Experience has shown that even illiterate mothers can understand the significance of an increase or decrease in weight, once they are taught that a child's failure to gain weight indicates either the presence of disease or lack of food. If an inadequate food supply is detected early, a minor adjustment in the family diet can prevent permanent retardation of growth and development. Weighing programs within the home or village should be a cornerstone of any program aimed at reducing childhood malnutrition.

Other specific measures can be used to lower the frequency of infectious disease and thus reduce the effects of malnutrition. Health-care workers can help improve village sanitation and personal hygiene and make sure there are ample water supplies. Immunization against the common communicable diseases of childhood—diphtheria, tetanus, whooping cough, measles, and poliomyelitis—also guards against infection and malnutrition. However, an immunization program requires a degree of government commitment that is lacking in many developing nations.

Yet these same countries continue to receive millions of dollars in U.S. aid for "strategic" reasons, assistance that often enriches the officials of the recipient countries and their friends and political allies.

It seems obvious that food aid should be kept as free of donor politics as possible and dispensed on the basis of need and effective utilization. One way of achieving this is to offer food and financial support to needy countries through international channels. The problem is that international agencies also vary in the soundness of their policies. In general, though, assistance by international agencies or groups of countries is preferable to direct aid from individual countries.

Because the World Bank and its associated lending agencies provide massive financial assistance, they have the greatest leverage in persuading governments to adopt sound economic policies of popular benefit. The United Nations Development Fund (UNDF), also funded by the industrialized nations, is similarly influential. But because these agencies must deal with governments of varying motivation, competence, and integrity, and because the judgment of their own personnel is sometimes flawed, their track record is erratic. Not all their investments prove to be in a country's best interests.

WHO and UNICEF are often effective in improving the nutrition and health of specific populations. These two agencies, for instance, have worked together to eradicate smallpox, reduce malaria and onchocerciasis (river blindness), and eliminate endemic goiter in many countries. Unfortunately, the two agencies do not have much political leverage with specific governments. The U.N.'s FAO also has little influence on government policies because its funding is largely tied up in bureaucratic overhead with relatively little left for field projects.

In 1975, the U.N. General Assembly established a new international agency, the United Nations University, to apply the instruments of scholarship—research, advanced training, and the dissemination of knowledge—to pressing global problems. The university's World Hunger Program, one of its first activities, has sought to use fellowship programs to train students from the developing world to deal with their countries' urgent food and nutrition problems. UNU now has an endowment of $140 million from 40 countries, including $100 million and a headquarters building in Japan. The U.S. government has not supported UNU because of its general disenchantment with the U.N., and because UNU's headquarters were located in Tokyo at a time when Congress was concerned with the imbalance of trade with Japan. Even so, this country's lack of involvement with UNU is a disgrace.

Some of the most effective food aid comes from nongovernmental organizations such as Oxfam, the Save-the-Children Fund, and some of the church-based service committees and programs. Projects supported by these groups usually stress community participation, and they often have an influence on government policy far out of proportion to the modest scope of their resources.

It should be obvious by now that foreign financial assistance, even of the magnitude proposed by the Kissinger Commission on Central America, is futile for many developing countries unless accompanied by dramatic changes in government policies. Assistance provided directly to national governments should be contingent on assurances that it will be used to benefit the countries' entire populations. For those countries unwilling to invest in such policies, I believe that the United States should not provide direct financial assistance—except during periods of acute emergency or on a project-by-project basis.

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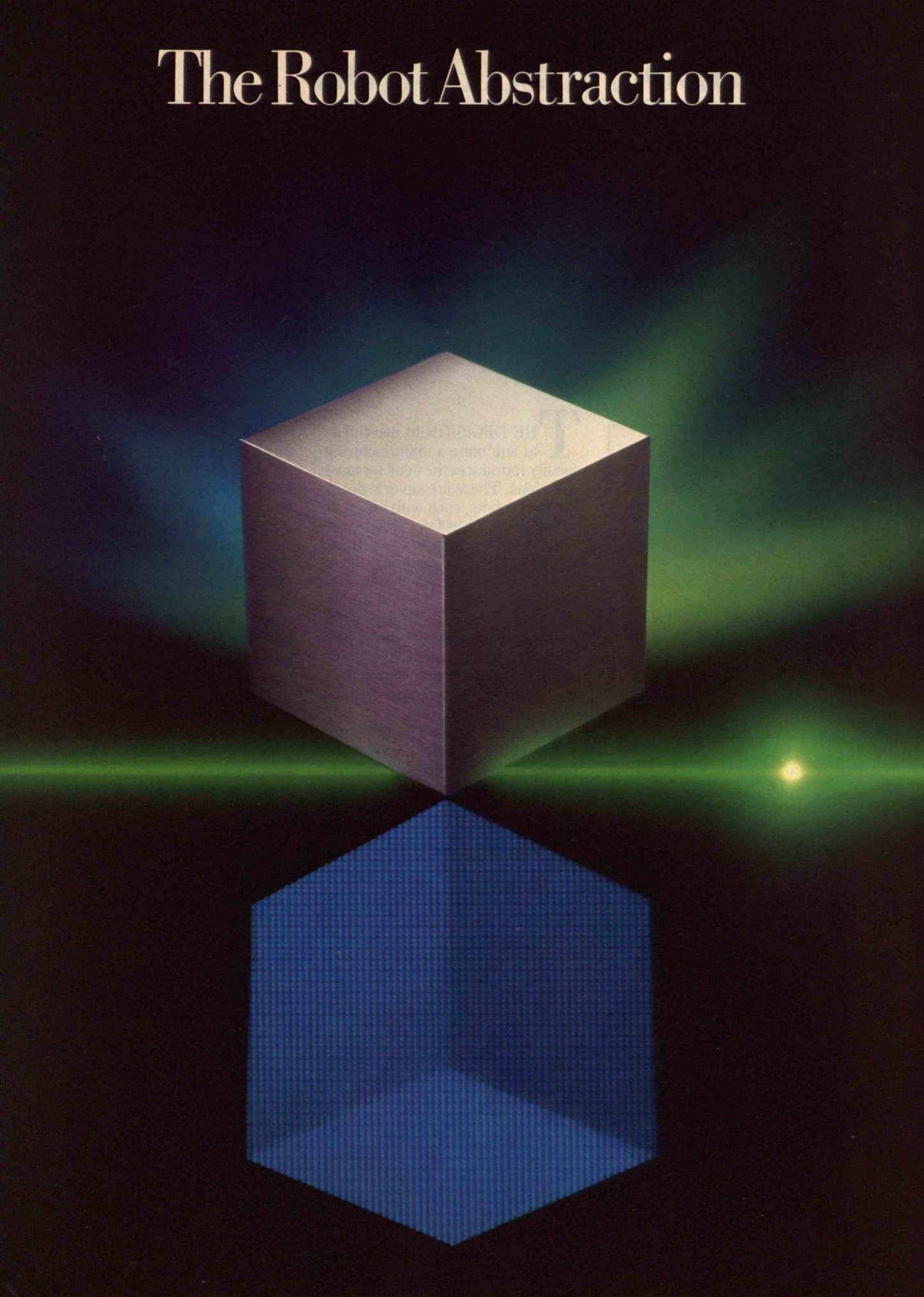
PHOTO: J. VON ACHER

The Robot Abstraction



The Robot Abstraction

Until now, matching robots to specific industrial tasks has been done by trial and error, requiring the creation of expensive prototypes. Recent advances at the General Motors Research Laboratories have produced a computer system that can be used not only to select the right robot, but also to program it to perform the task in the most efficient way.

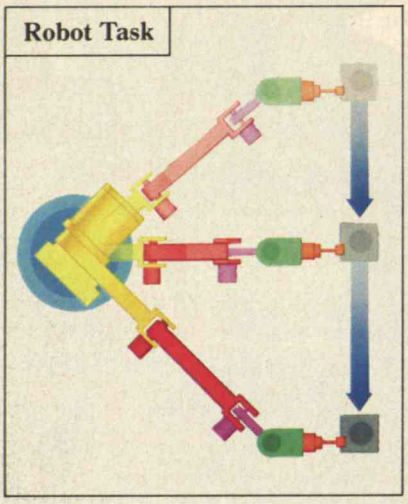
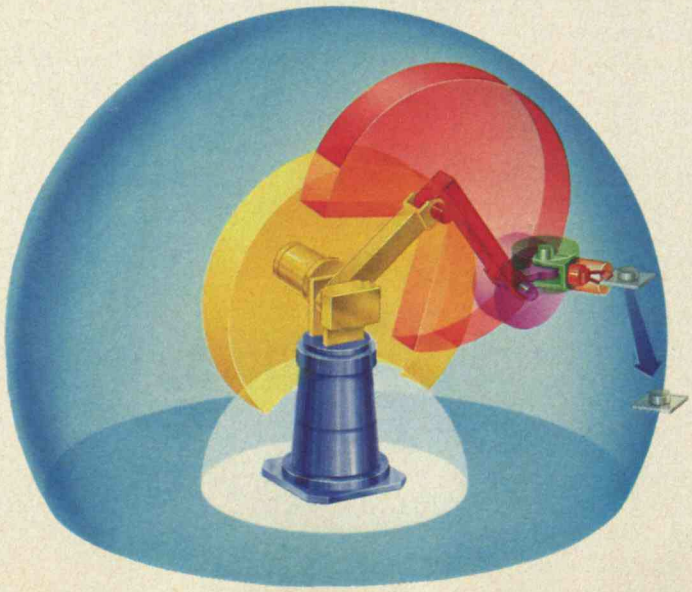


Figure 1: Two-dimensional overhead view of a robot task—the straight path trajectory of a solid.

Figure 2: Three-dimensional illustration of the robot work cell layout, showing reach capability for the task in Figure 1. Areas of color show total reach as well as the joint limits stored in the robot model.



THE DECISION to use robots to automate a manufacturing facility introduces the need for more decisions. There are several dozen kinds of robots, each with different capabilities. Thus far, choosing the right robot for a given set of tasks has been largely a manual process, involving great expenditures of time and money. By combining previously separate disciplines in a single computer system, two General Motors researchers have made the introduction of robots to the factory floor a more rational, less costly undertaking.

RoboTeach is the first computer system which integrates robotics, solid modeling, and simulation. It was designed and developed by Dr. Robert Tilove and Mary Pickett, both members of the Computer Science Department.

The use of powerful programming languages for manipulating robots is a major new development in the discipline of robotics. The languages specify desired robot motions, but they have no way of describing the robot's environment. Hence, they cannot automatically take into account physical obstacles or anticipate collisions. With only robot programming languages at one's disposal, assuring proper interaction with the environment requires testing with actual robots and parts.

Solid modeling, on the other hand, provides geometrically complete representations of environmental components and their spatial relations. But solid modeling cannot represent processes, because it has no way of representing temporal relations. Traditional solid modeling deals only with static relationships. While robot programming is without physical context, solid modeling is nothing but physical context. Neither by itself is adequate.

Nor are they satisfactory together. Only by simulation of both the robot and its environment can the sequence of discrete steps in a robot task be converted into the continuous motion of a process. Also without simulation, there is no way to represent accurately the robotic process as it unfolds in its environment.

RoboTeach, by combining all three disciplines, provides computer representations of the environment, the robot, and the task. Consequently, it helps users reach high-

level decisions about the real world without the investment of time or money in actual robots, actual parts, or the factory setting.

One key RoboTeach abstraction is a mathematical robot model. Solid modeling techniques represent the geometric form of each link of the robot. Then constraints are imposed on the relative positions of mating links to produce a mathematical abstraction of a mechanical joint. By insisting that the joint constraints always be satisfied, RoboTeach insures that the abstract robot model corresponds to a physically realizable geometric configuration.

OTHER representational facilities in RoboTeach handle robot task definitions. The representation of any task can be matched with the representation of any robot. In this way, RoboTeach helps users to determine the optimal robot for the task. Once a robot has been selected, RoboTeach can be used to program the robot off-line.

Not only are robots proliferating, but the tasks assigned to them are becoming more complex, making the need for off-line programming more urgent. When there are only a half dozen robots in a factory, the prospect of reprogramming them all by conventional show-and-teach methods for every new task is not overwhelming. But when there are hundreds of robots, the value of being able to reprogram without interaction with each robot becomes more apparent. Without off-line programming, the savings which justified the initial robot investment may quickly vanish.

RoboTeach distinguishes between two kinds of off-line programming: at the task level (what to do) and at the robot level (how to do it). For example, in the creation of a mechanical assembly, task-level instructions would include what components to assemble, the alignment of the components for the assembly process, and criteria for verifying that the final assembly is correct. Typically, there is a one-to-many relationship between task-level instructions and robot-level instructions.

"RoboTeach is currently in use," says Robert Tilove, "to study robot reach capabilities and to simulate simple robot-level tasks."

"Future research," adds Mary Pickett, "will explore the possibility of using RoboTeach to approach problems from the more abstract task level, with the user defining the task at a high level and RoboTeach filling in the details."

General Motors

GM

MARK OF EXCELLENCE

THE PEOPLE BEHIND THE WORK

Dr. Robert Tilove and Mary Pickett are Staff Research Scientists in the Computer Science Department at the General Motors Research Laboratories.

Mary Pickett received her B.S. in mathematics from Iowa State University and her Master's in computer science from Purdue University. She was a member of the team that developed GMSOLID, an interactive geometric modeling system. Her research at GM has also included the design of real-time programming languages. She joined GM in 1971.

Robert Tilove received his undergraduate and graduate degrees in electrical engineering from the University of Rochester. His Ph.D. thesis concerned the design and analysis of geometric algorithms for solid modeling. His current research interests also include the application of geometric modeling to computer vision and robot control. He joined GM in 1981.

Antisatellite Weapons: The Present Danger

Though antisatellite weapons could impair some military activities, they could not stop a nuclear attack. In fact, they might trigger one.

BY KOSTA TSIPIS AND ERIC RAITEN

DURING World War I aviators took to the air to observe troop movements on the Western Front. Soon aerial bombardment began, and dogfights raged in the sky as each side strove for "command of the air." The arms race in space has begun to develop along similar lines. But this time the threat of escalation affects the world's entire population. Satellite dogfighting could lead to nuclear war.

The United States and the Soviet Union first saw the potential of satellite reconnaissance in the fifties. Since then numerous satellites have been used to provide information

ILLUSTRATIONS: ROB COLVIN


CCCP

The Soviet antisatellite weapon is slow and unreliable, having failed more than half its 22 tests.

on industrial activities, military maneuvers, and missile tests. Reconnaissance satellites monitor arms-control agreements and stand ready to furnish prompt warning of a nuclear or conventional attack. Satellites help ships and submarines navigate more accurately and could help guide missiles, increasing their precision. Worldwide communications, military and civilian, depend critically on satellites.

Inevitably, the Russians and the Americans have been tempted to seek ways to destroy each other's satellites. As early as 1957 the United States began planning an antisatellite (ASAT) weapon in the Satellite Interceptor (SAINT) program. The plan was to send an interceptor into space and maneuver it to rendezvous with any Soviet satellite shortly after launch. Sensors would then have determined the satellite's purpose. If it had been for reconnaissance, navigation, or communications, it would have been left alone. If it had contained a nuclear warhead that presumably could have been delivered to a target on Earth, the interceptor would have destroyed it.

By 1962 the SAINT program had consumed twice its allotment of $60 million, its technical problems seemed intractable, and some officials saw that it was impractical to launch an interceptor every time the Soviets lofted a satellite. Besides, the ASAT seemed unnecessary, as it is very difficult to deliver weapons accurately from space to targets on Earth. As a result, the program was canceled.

That same year Defense Secretary Robert McNamara approved deployment of the army's Nike-Ajax missile system, which could launch a nuclear warhead 100 to 150 miles above the Earth to destroy a Soviet satellite. Nike-Ajax had actually been developed as an anti-ballistic-missile (ABM) system to intercept incoming Soviet missiles, but it was modified to function as an ASAT. A year later a similar system, the Thor missile, with a 400-mile ceiling, superseded the Nike-Ajax.

At about that time, U.S. defense scientists realized that a nuclear explosion generates an electromagnetic pulse (EMP) that can damage all satellites, enemy or friendly, for thousands of miles around. The U.S. Air Force tried to deploy a conventional warhead on a Thor missile to be used as an ASAT weapon, but destroying a satellite requires greater accuracy than the Thor could achieve. The Thor was dismantled in 1974.

Not long after the American U-2 reconnaissance plane flown by Gary Powers was shot down over the Soviet Union in 1960, Nikita Khruschev announced that U.S. reconnaissance satellites were also vulnerable. The Russians could hit "a fly in the sky," he boasted. His claim may have been premature, but the Soviets were indeed developing an ASAT weapon at the time. It is known as the Satellite Interceptor System (SIS).

These "killer satellites," as they are commonly called, are launched into orbit from the Tyuratum space complex in central Russia. A radar unit guides the SIS to its target. (The Soviets have also tried to use an infrared sensor, but it has not worked so far.) In actual use the SIS would explode and bombard its target with fragments. This system was first tested in 1968 and is now considered operational by the United States. However, it cannot be launched into an orbit high enough to threaten most U.S. satellites of military importance, and it is slow and unreliable, having failed more than half its 22 tests.

The Russian ASAT program has prompted a response by the United States, which is developing the Miniature Homing Vehicle (MHV). Launched from an F-15 fighter, this weapon is designed to rise directly toward its target and destroy it by colliding with it. The MHV is expected to be quick and able to reach most Soviet satellites, as nearly all of them are in orbits that approach close to earth. Though still largely untested, this homing vehicle will in all likelihood prove superior to the Soviet interceptor satellite.

Both the United States and the Soviet Union are also doing research on laser and other directed-energy weapons. Considered mainly as anti-ballistic-missile systems, these could also be used to disable satellites from installations in space, on aircraft, or on the ground. However, such weapons will not be practical for years, if ever.

The immediate issue is the present generation of ASAT weapons: the United States and the Soviet Union must decide whether to deploy them or to sign a treaty banning them. There is no time to hesitate. In January the MHV was fired into space, although not at a target. Once the MHV has been successfully tested, a treaty banning deployment could probably not be verified: the Russians would have no way of knowing whether any given F-15

A U.S. attack on early-warning satellites could provoke a Soviet nuclear strike but could not reduce its intensity.

carried the MHV. Their response would presumably be to develop a better ASAT, threatening important U.S. military satellites.

The Soviet Union has promised not to perform any more ASAT tests as long as the United States does not. The U.S. House recently voted not to authorize funds for testing the MHV as long as the Russians abide by their moratorium, and the Senate voted to allow testing only if the administration can certify that it is negotiating "in good faith" to limit ASATs. These attempts to halt the ASAT race and forestall a threat to peace are encouraging but tentative.

Vulnerable Satellites

With its far-flung naval operations, military installations around the globe, and advanced electronics technology, the United States has come to depend heavily on satellites. Most of its militarily important satellites are in "geosynchronous" orbit, 35,800 kilometers above the equator.

The Soviet Union does not use satellites to the same extent. Some of its satellites are simply less sophisticated, and it has traditionally prepared for conflicts in nearby areas such as Europe and the Persian Gulf, where satellites would help relatively little. Most of the satellites that the Russians do use are in elliptical "Molniya" orbits that approach to within 600 kilometers of Earth. Satellites in geosynchronous orbits would not be visible from most of the Soviet Union.

Military satellites play many important roles:

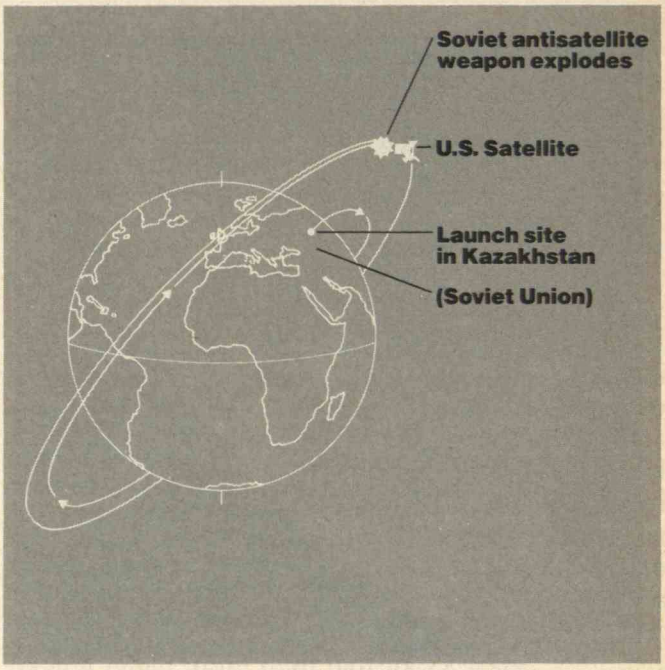
Communications. The United States has invested heavily in communications satellites, including systems for general military communications such as the Defense Satellite Communications System (DSCS), the NATO III system for NATO forces, and the Satellite Data System (SDS) for communications in polar regions. The United States also has specialized military communications systems, such as the navy's Fleet Satellite Communications System (FLTSATCOM) and the Military Strategic Tactical and Relay System (MILSTAR). The latter, not yet operational, is intended for strategic nuclear forces such as submarines and bombers. About 70 percent of all U.S. military communications are now carried by satellite.

The Soviets have a smaller satellite communications network. It includes three groups of Molniya satellites, one solely for military use, and three or four groups of Cosmos satellites, also apparently for military use. The Soviets need fewer such satellites because they have extensive land-based communications facilities. These ground stations are often redundant: even if many individual installations were destroyed, the system would still function.

Intelligence. Both countries deploy intelligence-gathering satellites. The United States has three photo-reconnaissance systems: the air force's Big Bird and Close Look satellites, as well as the Central Intelligence Agency's KH-11 system. Their capabilities are classified, but they can probably discern an object 5 to 15 centimeters in diameter on the surface of the Earth. The Soviet Union maintains two photo-reconnaissance systems.

U.S. electronic intelligence (ELINT) satellites intercept Soviet communications, including data about missile tests. ELINT satellites also provide information about air defenses, missile defenses, and early-warning systems. Soviet ELINT systems serve similar purposes and are far more extensive than U.S. systems. This may reflect the fact that the United States has an extensive network of listening posts in countries surrounding the Soviet Union.

After the Russian antisatellite weapon, the Satellite Interceptor System (SIS), is launched into orbit, a radar unit guides it toward its target. In actual use the SIS would explode and disable its target by bombarding it with fragments.



In response to recent Soviet naval expansion, the United states launched the Navy Ocean Surveillance Satellite (NOSS) system, which operates much as the ELINT satellites do, monitoring the radio and radar transmissions of ships. The navy is also developing a Radar Ocean Reconnaissance Satellite (RORSAT) that actively uses radar to detect ships at sea. The Soviet Union began to use RORSATs as far back as 1967 to locate surface vessels. Although for unknown reasons the Russian RORSATs operate for only three to six months of the year, U.S. naval officials worry that they could facilitate attacks on U.S. ships. Since 1974 the Soviet Union has also employed ELINT ocean-surveillance satellites.

Navigation. The United States recognized the potential for satellite-based navigation early in the space age and was able to bring its Transit system into operation in 1968. It consists of six satellites, each transmitting on two frequencies; one is encrypted and available only to military users. This system was designed to allow Polaris submarines to fix their positions, but it is also used for navy surface vessels, land surveys, and other purposes. With both frequencies available, military users can fix their positions with an error of less than 40 meters; civilian users with only one frequency can fix their positions to within 100 meters.

The Department of Defense recently began putting into place the Navstar GPS (Global Positioning System) satellites, expected to be operational in 1987. This system of 24 satellites will be used by submarines, naval ships, strategic bombers, ground troups, and satellites themselves to reduce positioning errors to as little as 10 meters. Navstar could also provide accurate guidance for cruise missiles, as well as other missiles equipped with a simple receiver.

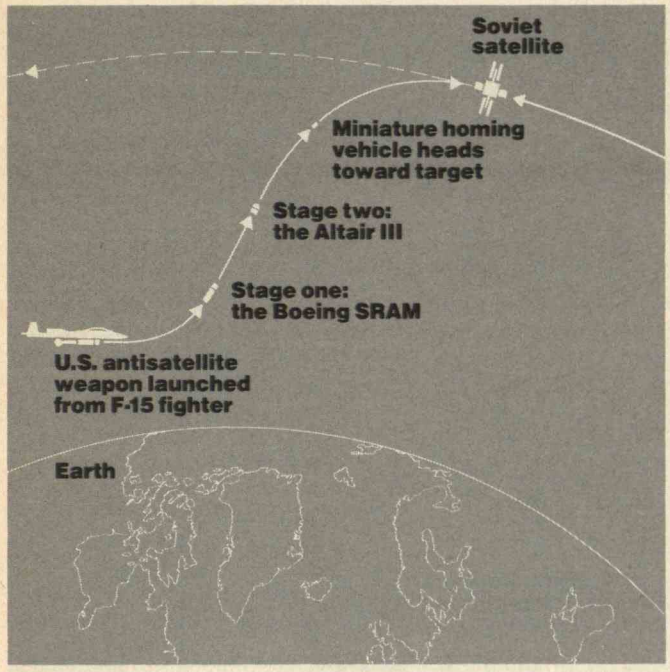
The Soviet Union began testing navigational satellites in 1967 with *Cosmos 192*. Today the Russians maintain two such systems, one primarily military and the other primarily civilian, both apparently similar to the Transit system. There are also plans for a system that apparently will be similar to Navstar GPS, but it is far from operational.

Early warning. U.S. ground-based radar installations can give at least 15 minutes' warning of an attack by Soviet ICBMs. But by recognizing the infrared radiation from an ICBM launch, the two U.S. Integrated Missile Early Warning System (IMEWS) satellites can provide about 30 minutes' warning of an attack, and thus can double the time available for making crucial decisions and launching retaliatory missions. The United States also maintains three Vela satellites to detect nuclear explosions in the atmosphere. Finally, an experimental device to detect strategic bombers from space will be tested on the space shuttle. The Soviet Union maintains an early-warning system of nine satellites, which also use infrared sensors to detect the launch plumes of ICBMs.

The Soviet ASAT

As it stands today, the Soviet antisatellite weapon, the SIS, poses little threat to U.S. satellites. This is mainly because it is limited in range by the capabilities of the F-1m launcher that boosts it into orbit. The basic F-1 rocket, a modified SS9 ICBM, has boosted 4,000-kilogram payloads into elliptical orbits with altitudes of nearly 1,600 kilometers. For the SIS, the so-called m-stage is added to allow further maneuvers, bringing the SIS to altitudes of 2,000 kilometers. This is nowhere near the militarily important communications and early-warning satellites of the United States, stationed in geosynchronous orbits 35,800 kilometers above the equator.

The U.S. antisatellite weapon, the Miniature Homing Vehicle (MHV), is launched from an F-15 fighter. The two-stage rocket is designed to rise directly toward its target and destroy it in a collision. The MHV will probably prove superior to SIS.



Height is not the only objective the SIS must achieve; it must also enter the same orbiting plane as its target. The SIS has never been launched into a plane parallel to the equator, where our geosynchronous satellites orbit. It has been launched only into planes with a 60-to-66° inclination, or angle with the equator. Any satellite launched directly from the Tyuratum site where the SIS is based will have an inclination of 45° or more. (The minimum inclination is equal to the latitude of the launch site.) The SIS orbit could be tipped up to a "polar" orbit bringing the satellite directly over the poles.

The m-stage can alter the inclination of the SIS once it is in space, but not by much—at most about 10°. The situation becomes even more problematic when the m-stage has to change both altitude and inclination, as would be the case in an actual attack. For example, in the *Cosmos 462* test flight of the SIS, the basic F-1 launched the ASAT into an orbit with a 62.3° inclination and a maximum altitude of 1,561 kilometers. If the inclination were changed 3°, then the high point of the orbit could theoretically be raised to some 3,500 kilometers.

If the full capacities of the SIS were utilized, only four U.S. satellite systems would be vulnerable:

☐ The NOSS system. These ocean-surveillance satellites are in circular orbits 1,100 kilometers above Earth at 63° inclinations.

☐ The Transit system. These navigational satellites are in polar orbits 1,075 kilometers above Earth.

☐ Reconnaissance satellites. These are in nearly polar orbits and all approach within 600 kilometers of Earth.

☐ Some weather satellites.

The vulnerability of the Transit navigation system matters little, since it is being replaced by the Navstar GPS system at 17,500 kilometers—too high for the SIS to reach. In addition, the Transit system has six satellites and the NOSS system has twelve. Destroying either would be enormously difficult for the slow, inflexible SIS. This is because it must be launched when the target passes near the SIS launch site, it takes about three hours to rendezvous, and it has had a success rate of only 50 percent. Unless the Soviets kept many SIS-equipped boosters ready to launch, they could attack only one or two satellites a day and could not maintain that pace for long.

U.S. reconnaissance satellites would be vulnerable to attack by the SIS but would probably be relatively easy to replace. Also, the locations of Soviet missile silos, military installations, factories, communication centers, and transportation hubs are already well known. Therefore, missiles could be aimed at these targets even if the satellites were destroyed.

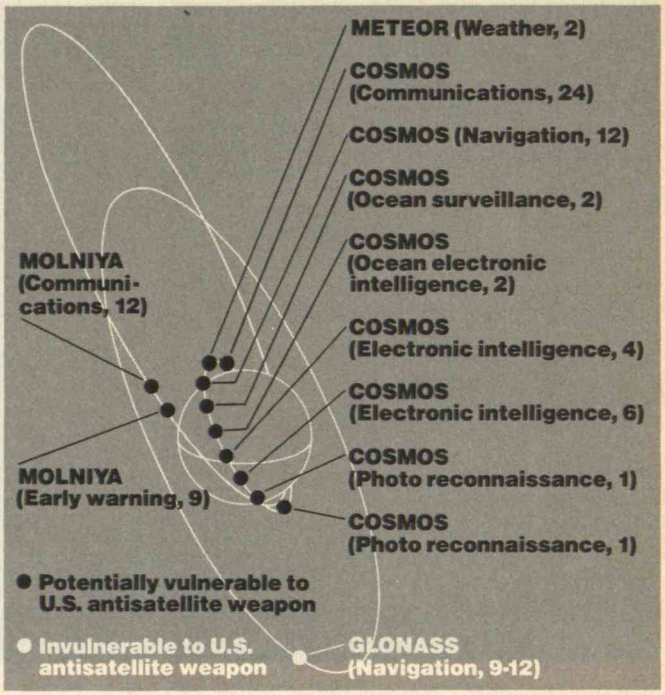
If the Soviet Union were left free to develop the SIS further, and in particular to mount it on the D-1 launcher, it could threaten U.S. satellites in geosynchronous orbits. The D-1 launcher has already shown its ability to lift a payload of 3,000 kilograms into geosynchronous orbit, and therefore could probably loft an ASAT, with some fuel for further maneuvering, to that altitude.

The U.S. ASAT

Unlike the SIS, which poses a minor threat to American military and civilian satellites, the MHV that the Vought Corp. is developing for the U.S. Air Force could very well prove capable of destroying key Soviet satellites. Although the MHV will reach only a limited altitude, most Soviet satellites are either in circular orbits 1,500 kilometers above the Earth or in Molniya orbits that come within 600 kilometers of Earth.

DIAGRAMS: OMNIGRAPHICS

Left: Since most Soviet satellites are in orbits that approach close to Earth, they may well be vulnerable to the U.S. antisatellite weapon (ASAT). Right: Most militarily important U.S. satellites are beyond the range of the Soviet ASAT. However, if the Russians are allowed to develop a more advanced ASAT with an improved launcher, they will be able to threaten all U.S. satellites. (The purpose and number of satellites in each system are in parentheses.)



The MHV's top-priority targets will be Soviet ocean-surveillance satellites, which Defense Department officials believe could aid Soviet forces in attacking U.S. and NATO fleets in a conventional war. Current plans are to field two squadrons of F-15s capable of launching the MHV, stationed at McChord Air Force Base in Washington and Langley Air Force Base in Virginia.

After being launched from an F-15, the MHV will be propelled toward its target by a two-stage rocket. The first stage consists of the booster rocket of the Boeing short-range attack missile (SRAM), originally designed to be carried by bombers for use against enemy air defenses. The second stage is a small missile, the Altair III, intended to add to the range of the MHV and make it rotate 20 times a second. The rotation both stabilizes the vehicle and aids its guidance system.

An inertial guidance system, which measures the forces on the missile to calculate its position, is mounted in the Altair to direct the MHV close to its target. At an altitude of about 650 kilometers, the MHV will separate from the Altair. The homing vehicle, weighing about 15 kilograms, will continue speeding toward its target at about 10 kilometers per second, steered by its own guidance mechanism.

The effectiveness of the MHV will depend primarily on the efficiency of this guidance mechanism. Its long-wave infrared sensor will be cooled to nearly -250° C to detect heat emitted by the target satellite. The power used by the Soviet ocean-surveillance RORSATs, which are prime targets, is presumably comparable to that used by similar civilian RORSATs—some 4 kilowatts of electricity. Since the power source has an efficiency of 20 percent, 16 kilowatts of waste heat will be radiated away in infrared waves of about 20 microns. When the MHV is near interception, the sensor will have to detect this radiation at a power level of a hundred-thousandth or a millionth of a watt per square meter. For reconnaissance satellites, also a prime target of the MHV, power levels of about a tenth that will have to be detected. That seems very demanding. But given present infrared-sensing technology, this goal seems well within reach.

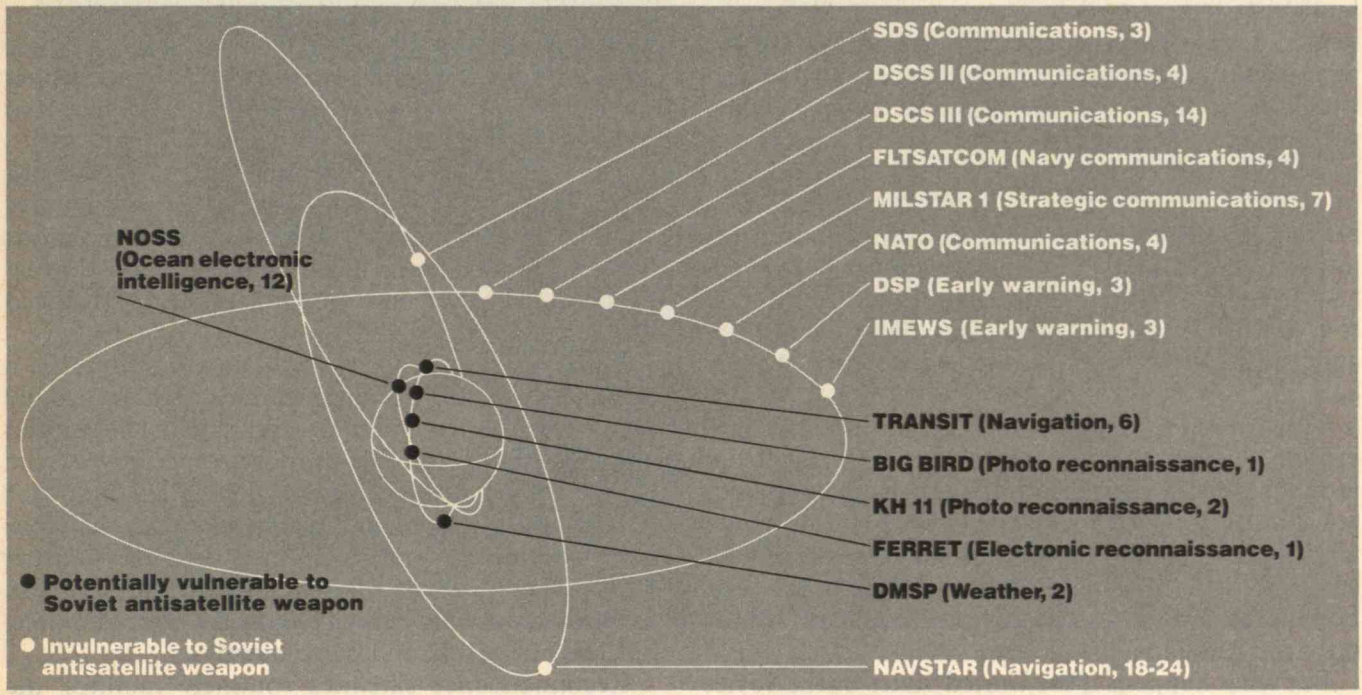
Identifying the target is only part of the problem. With information from the sensor and a laser-gyro timer, a computer will fire some of the 56 tubes of rocket propellant aimed perpendicular to the MHV's flight path to steer the ASAT on a collision course with its target.

Integrating such complex components has been difficult. Even so, unless funding is cut, this system appears to be headed toward complete testing against targets in space. They will radiate infrared waves in a pattern similar to that of Soviet satellites, and instruments carried by the targets will relay data to the ground on the performance of the MHV.

Although the MHV is still in a shroud of secrecy, its basic characteristics are certainly those of an effective weapon. A satellite would have a hard time maneuvering to avoid the homing vehicle, since it rises to heights of hundreds of kilometers in minutes. Furthermore, it is launched from an F-15, not a booster rocket with a large, easily detected plume. To confuse the MHV's sensor, the Soviet Union might try to modify the pattern in which its satellites radiate infrared, but the United States could detect any such modifications and compensate for them.

The General Accounting Office recently issued a report criticizing the ASAT for being over budget (the total estimated cost, including deployment, is $3.6

The United States depends far more on satellites than the Soviet Union and therefore has more to lose from antisatellite warfare.



billion) and for being incapable of attacking Soviet spacecraft in geosynchronous orbit. However, the vast majority of Soviet satellites approach close to the Earth. In any event, as Lieutenant General Thomas P. Stafford testified in a closed Senate hearing in 1979, the United States may attach the MHV to a conventional booster rocket to carry it to geosynchronous orbit. Data from NASA show that a number of conventional boosters, such as the Atlas/Centaur and the Titan III, can perform that task.

ASATs in War

What implications does this first generation of ASAT weapons have for national security, and what might the ultimate effects be of the untrammeled development of such weapons? Soviet-American strategic-defense policies are based on the fact that nuclear weapons are enormously destructive and, once launched, cannot be stopped from reaching their targets. This situation has created a condition of mutual deterrence that prevents each country from using its nuclear arms. If one nation were to strike first—even with a "counterforce" attack against missile silos—the victim would assuredly retain enough weapons, whether in remaining silos, on submarines, or on bombers, to retaliate and devastate the attacker's population and industry. The question is whether, by using ASAT weapons in conjunction with a counterforce attack, either nation could nullify the other's ability to retaliate.

First consider the current generation of ASATs. The Soviet SIS cannot attack U.S. communications or early-warning satellites, since they are in geosynchronous orbits. The MHV could attack Soviet communications satellites, but the Russians have redundant land-based systems to communicate with the bulk of their strategic forces, which are ICBMs. The MHV could also attack Soviet early-warning satellites, but doing so would merely serve notice of an impending nuclear strike, even if the United States intended no such thing. Such an ASAT attack entails the dangerous likelihood of provoking the Soviet Union to launch its ICBMs but could not limit the intensity of a Soviet first or retaliatory strike.

Either country might be able to use its current generation of ASATs to destroy its opponent's reconnaissance satellites. Suppose one side did this while

Once the U.S. antisatellite weapon has been tested, a treaty banning deployment could probably not be verified.

launching a first strike. The victim could be prevented from observing and retaliating against the aggressor's bombers and mobile ICBMs (if any existed). The victim would also have difficulty assessing the damage from the strike, and would not be able to tell which of the aggressor's fixed silos still contained missiles. However, because of EMP and other effects of nuclear war, reconnaissance satellites might well be useless anyway. Whatever happened, ASATs could not increase the magnitude of the first strike, and the victim could still retaliate against the aggressor's cities and industries, devastating the country.

Thus, neither power could use the present generation of ASATs to prevent its opponent from launching a first strike or retaliating against cities and industry. This means that neither nation could alter the outcome of a nuclear attack or the general strategic balance. This is true regardless of whether both sides deploy ASATs, only the Americans do, or only the Russians do.

But what happens if the United States or the Soviet Union deploys an advanced ASAT system that can rapidly destroy numerous enemy satellites, including those in geosynchronous orbit? There have been suggestions, for example, that directed-energy weapons, which both countries have been trying to develop, might be used in this way.

Destroying reconnaissance satellites with advanced ASATs, as with the current generation, would not affect the outcome of a nuclear attack. Likewise, destroying early-warning satellites with advanced ASATs would merely alert the victim to ready its nuclear forces or launch a nuclear strike.

An advanced ASAT attack on navigation or communications satellites could be significant. The United States deploys many missiles on submarines, and they are already quite accurate. Navigational satellites could make these SLBMs, as well as cruise missiles, capable of retaliating against silos or other hardened targets. An attack on U.S. navigational satellites would impair this capability. Of course, the same would be true for the Soviet Union if it ever developed a similar capability.

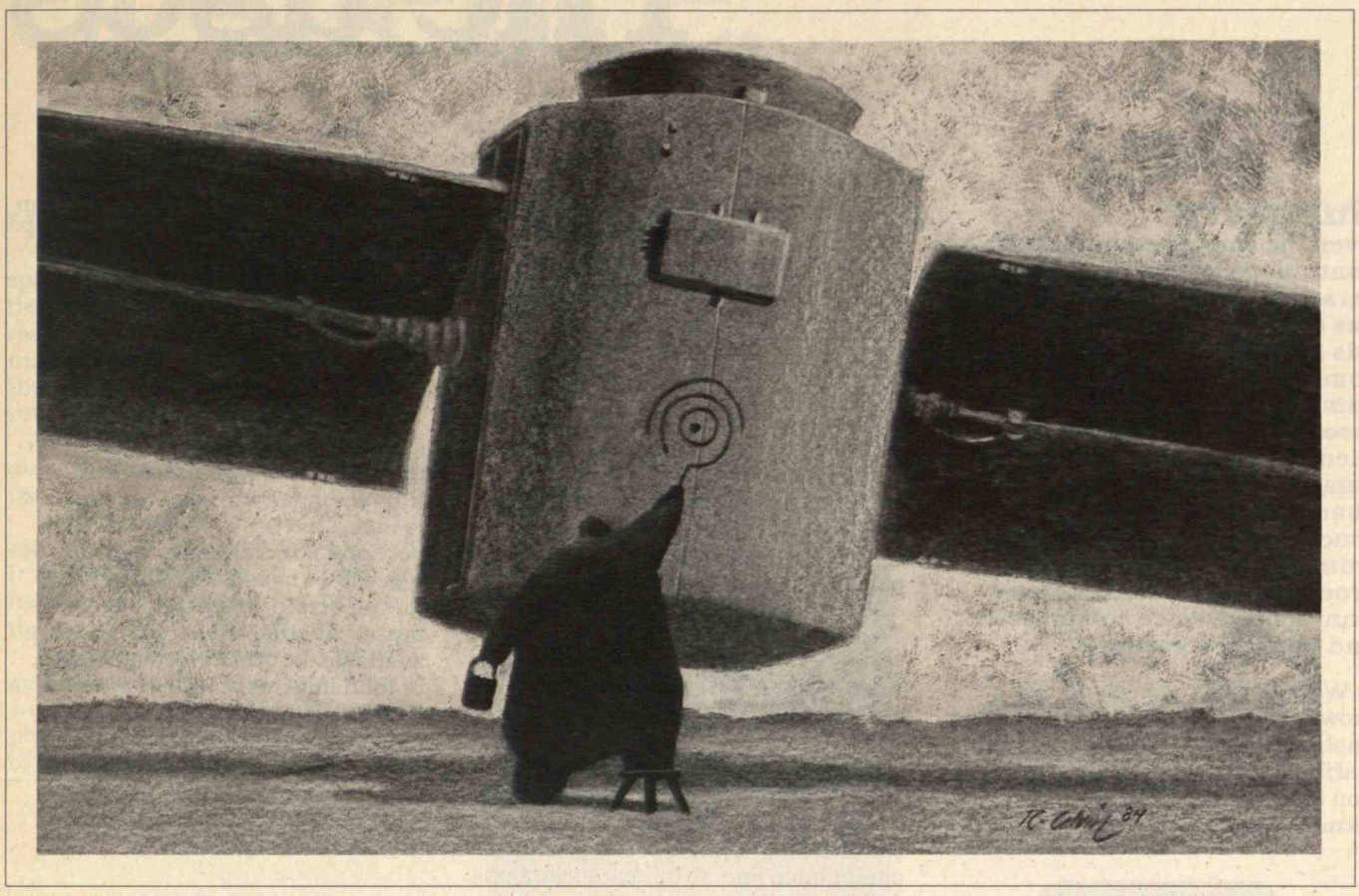
Equally important, by destroying U.S. communications satellites, the Russsians could impair this country's ability to conduct a controlled retaliatory strike from submarines against any targets. However, slower, more cumbersome communications with submarines would still be possible, so they would by no means be prevented from launching some form of retaliatory strike. Bombers could also perform such a strike.

Thus, even the most advanced ASATs would not allow either side to prevail in a nuclear war. ASATs would become significant only if one or both nations developed space-based defenses against ballistic missiles, since these would be vulnerable to advanced ASATs.

In the near term, ASATs could be more useful in a conventional war. Communications are increasingly important for the military, and satellites are used more and more for this purpose, especially by the United States. Navigational satellites are used not only to allow troops and airplanes to fix their positions accurately, but to aid in antisubmarine warfare and in refueling aircraft in mid-air. Most of these functions could probably be done without satellites, but less effectively and conveniently.

Reconnaissance satellites routinely monitor the course of fighting (both the Soviet Union and the United States used such satellites during the Falklands conflict) and observe large-scale troop movements in rear areas. For example, in a European war, monitoring Soviet second- and third-echelon divisions or U.S. convoys crossing the Atlantic would be more difficult without satellites. Information about such movements could be inferred only by intercepting radio communications or by performing reconnaissance from high-flying aircraft.

Since the SIS threatens U.S. reconnaissance satellites, and if developed the MHV would threaten a number of Soviet satellites, including those used for reconnaissance, the current generation of ASATs could affect a conventional war. Advanced ASATs could be even more significant, particularly in threatening the 70 percent of U.S. military communications now carried by satellite. The Soviet Union would have an advantage, since it depends much less on satellites for military operations than does the United States. Furthermore, Soviet satellites tend to be shorter-lived than U.S. satellites, partly because they contain less sophisticated electronics and optics. This means that the Russians are used to replacing their satellites routinely and easily—a distinct advantage in ASAT warfare.



Reaching an Agreement

Because of its technological sophistication, the United States would probably develop an ASAT capable of destroying satellites in geosynchronous orbit before the Soviet Union. However, the Russians would undoubtedly follow suit, especially given the fact that they already have large rocket boosters. Once they do, they will retain an everlasting advantage. Since it depends far more on its satellites than does the Soviet Union, the United States would probably be deterred from instigating ASAT warfare, but the Russians might very well not be. Thus, it is in this country's interest to keep the Soviet Union from improving its ASATs. The only way to do so is through a treaty.

If its testing is successfully completed, the MHV will be superior to the SIS. Thus, in the best of all possible worlds, the United States would negotiate a treaty allowing the current generation of ASATs but outlawing future developments. However, it is doubtful that the Russians would countenance such an agreement. The Soviet Union would more likely be willing to give up its advantage in proceeding with the second generation of ASATs if the United States gave up its advantage in the current generation and agreed not to test the MHV.

The most negotiable ASAT treaty would ban further testing and deployment of all ASAT weapons—a treaty not unlike that proposed by the Soviet Union in August of 1983. The only serious hesitation the United States could have about such a treaty concerns whether it could be verified. There seems to be no reason why a test ban could not be verified with reconnaissance satellites and space-surveillance facilities such as ground-based telescopes, and no nation could confidently deploy a weapon without thorough testing.

"Breakout"—the chance that one country will develop a powerful ASAT behind the shield of a treaty and then suddenly deploy it—would still be possible. However, even if the Russians did this, they would gain only a limited advantage: a unilateral ASAT capability would not be significant in a nuclear war. Despite the small risk, a treaty stopping the Soviet Union from unfettered development of its next generation of ASATs would be a bargain for the United States.

KOSTA TSIPIS, author of Arsenal: Understanding Weapons in the Nuclear Age *(Simon & Schuster, 1984), directs the Program in Science and Technology for International Security at M.I.T. ERIC RAITEN is an undergraduate working in that program.*

The uses

Summary:

Even the smoothest voice is discontinuous, especially in conversation. Data communications has bursts of message and periods of silence, too. Even TV has some "bursty" traits. GTE scientists are isolating silences and inserting other messages into them. This permits voice and data to coexist on the same channel at the same apparent time. The development stems from parallel research in microelectronics, silence detection, speech, voice compression and signal processing.

Without basic change, or vast growth, telephone networks will be unable to cope with the anticipated traffic of the 1990's. The proliferation of personal computers and data terminals has already placed a strain on switching and transmission facilities. It has also placed demands on networks that are much different from the original voice-communications concept, in which average time of connection was three minutes.

Today, far shorter and far longer connections abound, more subscriber lines are in demand, and there are growing needs for enhanced services and faster switching.

Out of research dating from 1979, GTE has developed a switching system that promises not only to triple present transmission capacity but also to process calls 20 times faster. The system is called Burst Switching.

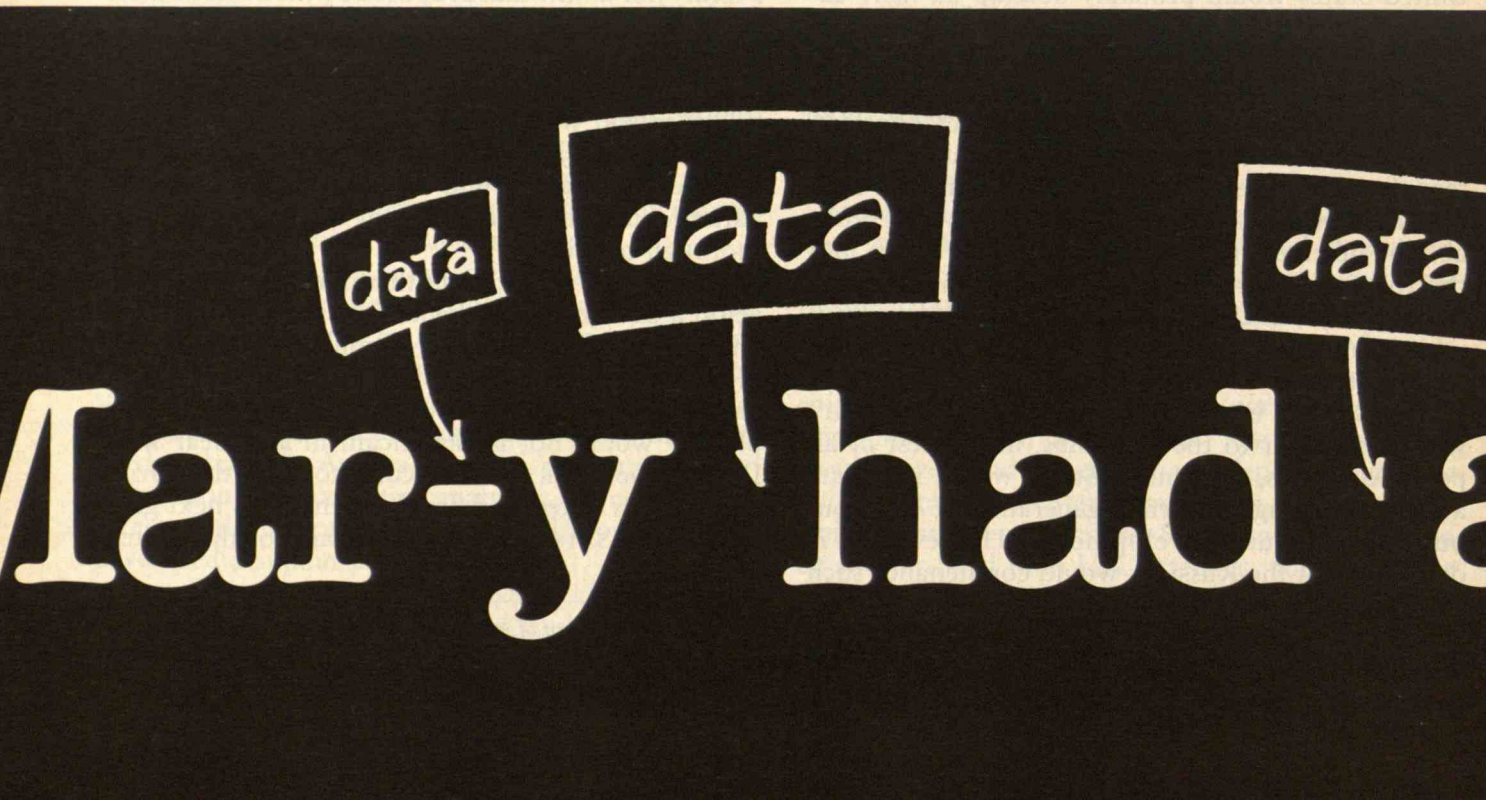
The nature of speech.

Our world is full of holes. Matter is mostly empty space. Conversation is mostly silence. But, even though speech is 2/3 silence interspersed with bursts of sound from 0.1 to 1.5 seconds long, if that speech goes over a telephone line, the line is locked up for the duration.

But, with Burst Switching, we can shoehorn other messages into the silences, automatically easing the pressure on transmission facilities. Theoretically, in fact, we triple transmission capacity.

VHSIC.

Through Very High-Speed Integrated Circuits (in which we are currently researching devices with submicron feature size), we are able to make and break telephone connections at increasingly high speeds. Voice lines need be dedicated only for the very brief duration of voice bursts. At other times, channels are available for other voice messages, or for data streams which are also "bursty" in nature. In addition, video, because of its built-in redundancy, can be considered to have bursts, too.



# of silence.

Message compression.

The capacity needed to transmit speech can be made even smaller if the information that must be sent to make it recognizable can be minimized. Our scientists have reduced the 64 kb/s signals to 16 kb/s while retaining high quality.

Thus, transmission-capacity requirement is reduced by a factor of four.

We are working, as well, on techniques for compressing video signals from 90 Mb/s to 64 kb/s. This will have special relevance for such activities as video conferencing.

So transmission capability grows and switching becomes faster—and we can now envision future telephone systems able to carry billions of simultaneous calls.

The box at the right lists some of the pertinent papers GTE people have published on Burst Switching and related subjects. For any of these, you are invited to write GTE Marketing Services Center, Department TPIIC, 70 Empire Drive, West Seneca, NY 14224.

Burst Switching experimental model.

Pertinent Papers.

Burst Switching—An Introduction, IEEE Communications Magazine, November 1983.

New Switching Concept Integrates Voice and Data Bursts, PROFILE, September 1983.

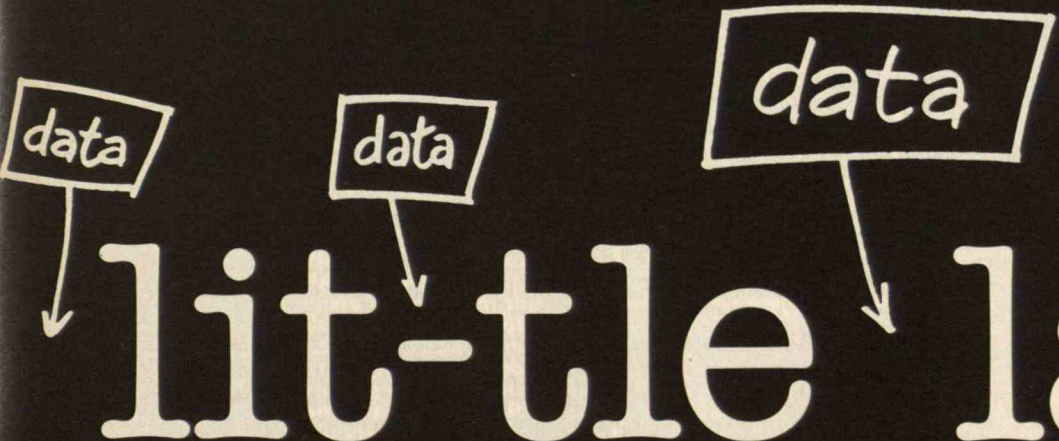
A PCM Frame Switching Concept Leading to Burst Switching Network Architecture, IEEE Communications Magazine, September 1983.

Application of the Burst Switching Technology to the Defense Communications System, Proceedings 1983 IEEE Military Communications Conference, MILCOM '83, Washington, D.C.

Performance Evaluation of a Distributed Burst-Switched Communications System, Proceedings Second Annual Phoenix Conference on Computers and Communications, March 1983.

A Complementary Speech Detection Algorithm, Proceedings of GLOBECOM '83, November 1983.

GTE



In Burst Switching, the roughly 65% silence in speech can be filled with data streams and other messages, effectively tripling transmission capacity.

Tucson's water budget is badly out of balance. Technological advances and cultural changes are in the works—but will they be enough?

Trouble in a Thirsty City

BY TONY DAVIS

TUCSON, ARIZ.—With every rain, the Santa Cruz River, which cuts through the west side of this desert city, lives. Water flows from brim to brim, beaming tantalizingly at anyone crossing one of the river's many bridges. An occasional tree trunk scurries downstream, often accompanied by tires, barrels, and other discarded bits of civilization.

When rains are too heavy, the Santa Cruz runs wild. Last October, for example, when six inches of rain fell in six days, the river swallowed condominiums, office buildings, trailers, and houses like nuggets of candy. Some people stood on the banks and cheered. They were happy, said one, "to see a river kick ass."

But the water always vanishes soon after the rain stops, leaving behind only scattered mud flats and rocks stretched across the streambed.

It wasn't always so. Before the turn of the century, parts of the Santa Cruz ran continuously—havens for herons and ideal picnic spots. By 1940, however, the river had played out its hand. The Santa Cruz became the first place in Tucson to go dry. Today many people wonder whether the rest of this growing metropolis of more than 500,000 will suffer the same fate. Indeed, "running out of water" has become a cliche here as it has across much of the West, where aridity is a way of life.

For example, in 1986 Los Angeles will lose 60 percent of its share of water from the Colorado River to the Central Arizona Project (CAP), a massive aqueduct system that will carry water from Lake Havasu to Phoenix and eventually to Tucson. If officials cannot find new sources of water, southern California could face serious water shortages during dry periods as early as 1990.

In Denver, officials limited outdoor watering for several years because of delays in building a new water-treatment plant. Now they urge residents to water outdoors only once every three days. The city recently started up a plant to test the feasibility of recycling treated sewage water for drinking. And in Salt Lake City, planners are counting on an as-yet unbuilt dam to keep them from running short of water by the year 2000.

Unlike those cities, however, Tucson has no supply of surface water and will have none until CAP water arrives in the early 1990s. Thus the city has had nowhere to go but down to the underground aquifer. Tucson is the only U.S. city of its size so dependent on groundwater. And like any veteran junkie, the city has paid a price: overpumping has dropped the water table by 180 feet in some areas.

Yet as mandated by an almost revolutionary state law—the Groundwater Management Act—officials must stop the overdraft within 40 years while keeping the 1 million immigrants expected by then from going thirsty. It can be done: Tucson is a long way from actually running out of water. But the city has run out of easy—and cheap—solutions.

Groundwater Mining

The Tucson Active Management Area of the Arizona Department of Water Resources is both a political subdivision and a desert playground. It spans 4,500 square miles of mountains, gently sloping grassland, and upland dotted with saguaro cactus and palo verde trees. Much of the region receives only 11 to 12 inches of rainfall each year—totaling 2.5 million acre-feet of water, or enough to cover 2.5 million football fields with a foot of water.

In Tucson, most of the rainfall evaporates or runs off in rivers into the surrounding desert. Only 68,000 acre-feet percolate into the aquifer. Another 71,000 acre-feet seep down from wastewater from farms and households. But every year, local residents, farms, and copper mines pump more than 400,000 acre-feet of water out of the aquifer. This process, dubbed groundwater "mining," violates a hydrologic maxim known as "safe yield," which says that less water should be pumped out than is replenished.

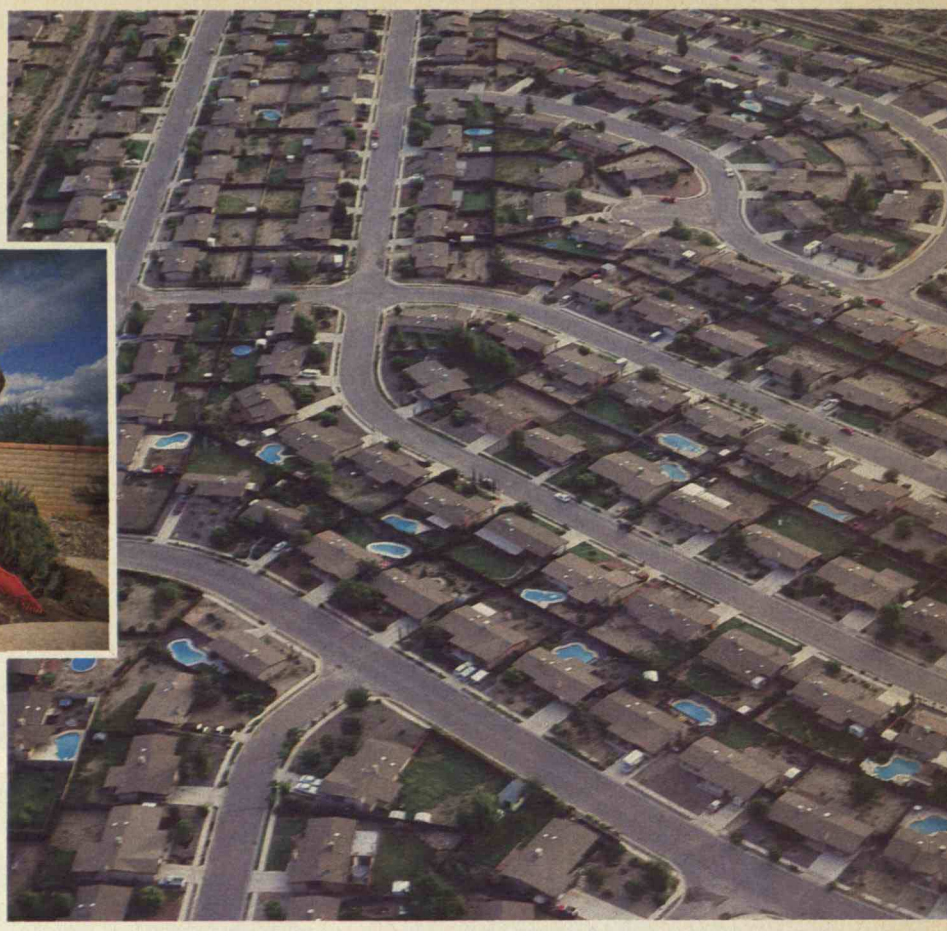
As the water table sinks, pumping costs soar. Water quality declines, since deeper water is more likely to be contaminated with naturally occurring salts. And officials fear that continued overpumping could cause the ground to sink—a geologic phenomenon called subsidence that can trigger fissures in the earth and cracks in buildings, streets, and pipelines. Already more than 100 earth fissures have appeared across Arizona, including one more than nine miles long. But the only hint of subsidence in Tucson has been a quarter-mile-long, four-foot-wide crack that opened up in a farming area west of the city in 1981—and no one has yet proven that subsidence was the cause. Workers for the highway department who dropped rocks, brooms, and rakes in the crack never heard them hit bottom.

Nobody worried much about safe water yield back in 1910, when the first major farming operation opened in Tucson. Owners of the Tucson Farms began raising dozens of crops on 12,000 acres—"everything but citrus," wrote George Wharton James in his 1917 book, *Arizona the Wonderland*. "There is no severe frost, and, with the abundant supply of irrigation water, drought is unregarded." He quoted

TONY DAVIS reports on water-related issues for the Tucson Citizen.

PHOTOS: JOAN RENNICK, *TUCSON CITIZEN*; U.S. BUREAU OF RECLAMATION

The Central Arizona Project, which will carry water from the Colorado River, holds hope for Tucson and other parched areas. A vast system of canals and pipes, the CAP slowly takes shape across the desert from its intake on Lake Havasu. But the CAP alone will not balance Tucson's overdrawn water budget.



Urban sprawl, paced by waves of immigrants from the East, adds to Tucson's water worries. Newcomers often put in swimming pools, huge lawns, and thirsty non-native trees. But homeowners are now encouraged to save water by "thinking natural." Here, Dave Monte has created a desert-inspired landscape in his family's backyard.

an engineer with the U.S. Reclamation Service, a forerunner of today's Bureau of Reclamation, as saying the area had a "permanent and constant water supply."

The farm's diversion-ditch irrigation system was crude but effective. And by the 1940s, when more than 40,000 acres were being tilled in surrounding Pima County, farmers here, like farmers across the West, were using high-speed pumps that let them water twice as many acres for half the cost. Farmers then used about 85 percent of all water pumped in the Tucson area. Even today, although the city has purchased 12,000 acres of farmland for the water rights, agriculture still uses 58 percent of the county's water.

Gardens of Eden

Waves of Anglo immigrants also began arriving from the East early this century. They abandoned the area's Spanish tradition of creating small, peaceful backyard oases complete with fig trees. Instead, says Charles Sacamano, a horticulture professor at the University of Arizona here, "the thing you did was to scrape off the desert and put in a Garden of Eden."

These Edens included huge lawns peppered with non-native mulberry trees, which use 35 or more times the water that native bright-green palo verde trees use. Backyards began sporting new swimming pools at the rate of 1,000 to 2,000 a year. And golf courses, each gulping enough water for up to 6,000 persons, popped up at a higher per capita rate than any Western city except Phoenix.

The state's water laws, which gave farmers, ranchers, and other landowners the right to pump as much groundwater as they wanted, stacked the deck against conservation. Local water rates, which until the 1970s declined as one used more water, also abetted such profligacy. While the rates have increased in recent years, they haven't always kept pace with inflation. And when four City Council members voted to raise water rates sharply in 1976 to encourage conservation, they were recalled from office within months.

Fostering this wasteful spirit was "a philosophy and lifestyle of use and growth," says Marybeth Carlile, executive director of the Southern Arizona Water Resources Association (SAWARA), a business-backed group that has launched a major conservation campaign. "We've always been assured that there was plenty of water for forever."

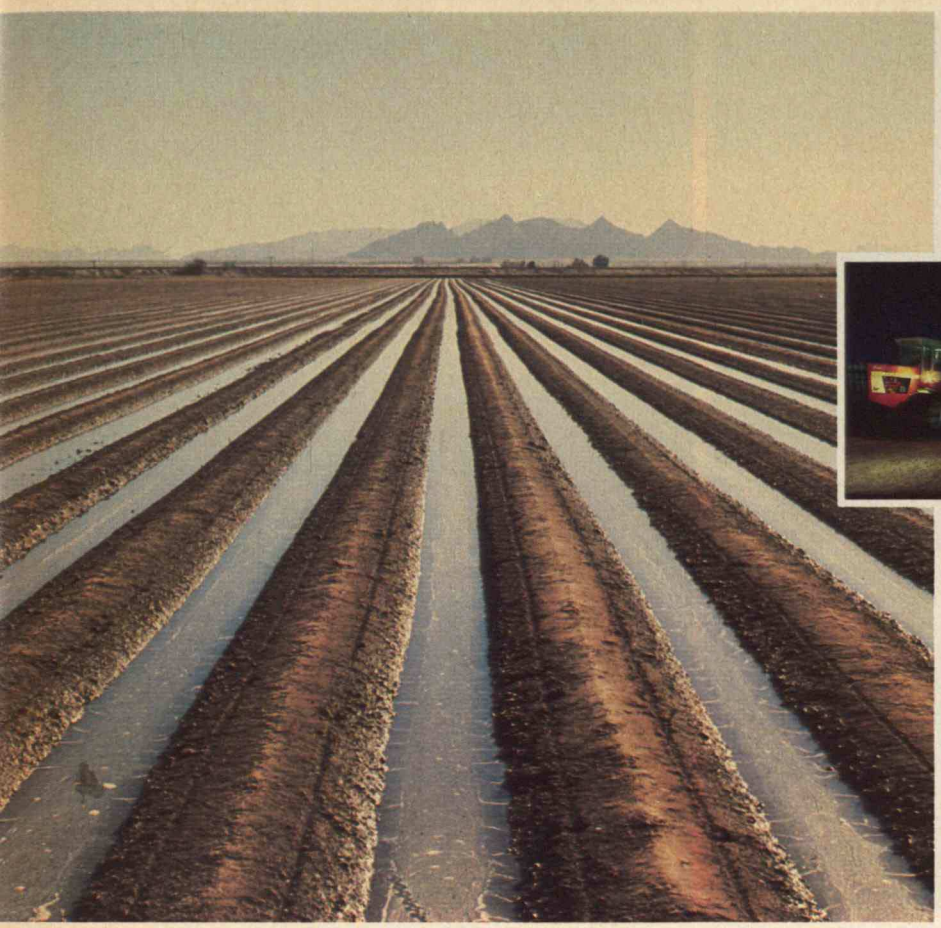
Charles Bowden, a Tucson author and newspaper writer, carried that argument a step further in his 1977 book, *Killing the Hidden Waters*. He wrote that "to ask the economic sector to solve the problem of groundwater depletion is to ask it to self-destruct." Bowden quoted Tucson hydrologist John Harshbarger as saying that safe yield is not economically feasible, and that "experience has demonstrated that bold decisions to utilize groundwater sources in excess of natural replenishment have proved to be a realistic water management method."

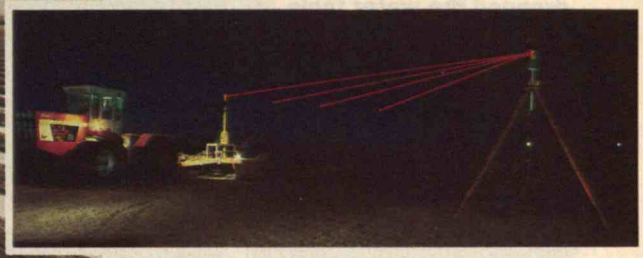
That, in a somewhat parched nutshell, is how the Tucson area and the rest of the state behaved until recently. While groundwater mining made the economy tick, Arizona leaders plotted for three decades to get federal approval of the CAP. The project, whose canals and pipelines will lift Colorado River water 1,200 feet and ship it 300 miles, was finally authorized by Congress in 1968 and today is approaching Phoenix.

Arizona's water users will eventually repay much of the CAP's $3.1 billion price tag. Cities will get a bargain interest rate of just over 3 percent. Farmers will pay no interest, and their payments will be less than their share of the construction costs, thanks to a legal provision that allows them to be charged according to their ability to pay.

The CAP will provide Arizona with an average of about 1.2 million acre-feet of water a year for 50 years. But it clearly will not solve the water problem alone,

PHOTOS: DAVID SCHREIBER, *TUCSON CITIZEN*; PETER KRESAN





Farming drinks up 58 percent of the water pumped from Tucson's underground aquifer. But a new state law will force farmers to increase their irrigation efficiency—the amount of water actually reaching crops—by 20 percent. Laser-leveling offers one path to that goal. A tractor guided by a laser beam scrapes fields almost perfectly flat so water will soak in uniformly (above and left). Top: Irrigation is complete on upper two leveled fields while the third field is being irrigated.

since the state's total overpumping in 1980 was 2.2 million acre-feet. That year Cecil Andrus, then secretary of the interior, cracked down, threatening to withhold CAP water unless officials agreed to curb the overdraft. Thus, the state legislature passed the landmark Groundwater Management Act declaring groundwater a public resource and giving the state the power to reduce its use. The law makes safe yield a state goal and sets a deadline for the year 2025.

Dowsing for New Sources

In a variation of supply-side economics, state and local officials are counting heavily on new water sources in addition to the CAP to balance the groundwater budget. For example, Tucson is gearing up to use the area's sewage effluent, most of which now rolls out of two sewage plants into the Santa Cruz River—and then out of the area. The city will spend $35 million over the next decade on a system to carry 20,000 acre-feet of effluent annually to golf courses, parks, and cemeteries. Officials expect to eventually use all the municipal effluent, which by the year 2000 will exceed the amount of rainwater entering the aquifer each year.

The rest of the overdraft is supposed to be eliminated by a series of five state-run conservation plans. The first, just promulgated, takes effect in 1986, and each succeeding decade will see another plan. The scenario is clear: less farming and less water for everyone.

For the first time, farmers will have to measure how much water they use and pay for it. They will have to reduce groundwater pumping gallon for gallon to match the CAP water that they receive. And the state has the right, beginning in 2006, to impose a "pump tax" and use the money to buy out farmers to reduce pumping.

By 1986, farmers must install systems to pump water running off their fields back onto the fields, and they must line irrigation ditches to keep water from seeping into the soil. Farms will be allotted a maximum amount of water and must improve their irrigation efficiency—the amount of water actually reaching crops—from 65 percent today to 70 percent by 1986 and 85 percent by 2025.

Laser leveling, in which a tractor guided by a laser beam grades fields as flat as a pie pan so that irrigation water will soak in uniformly, is one possible path to that goal. Drip irrigation, which releases tiny amounts of water directly onto crops at specific times, is another. Both can achieve up to 95 percent efficiency.

Industries will be required to recycle more water. Golf courses, long a target of conservationists, must reduce their water use slightly, with new courses facing tougher restrictions, including limits on how much turf they can plant. And artificial lakes and swimming pools larger than Olympic size will be banned.

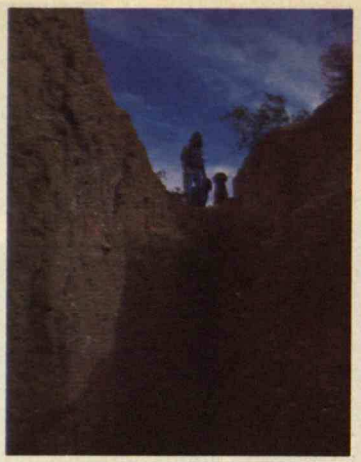
Homeowners will have to reduce their use of water by 6 percent during the first plan and more during later plans. Cuts will likely be spurred by increases in water rates. Officials hope that homeowners will replace their Edens with "mini-oases"—yards styled partly with grass and partly with desert plants—and that they will cover swimming pools to reduce evaporation and replace toilets with slow-flow systems using several gallons less per flush.

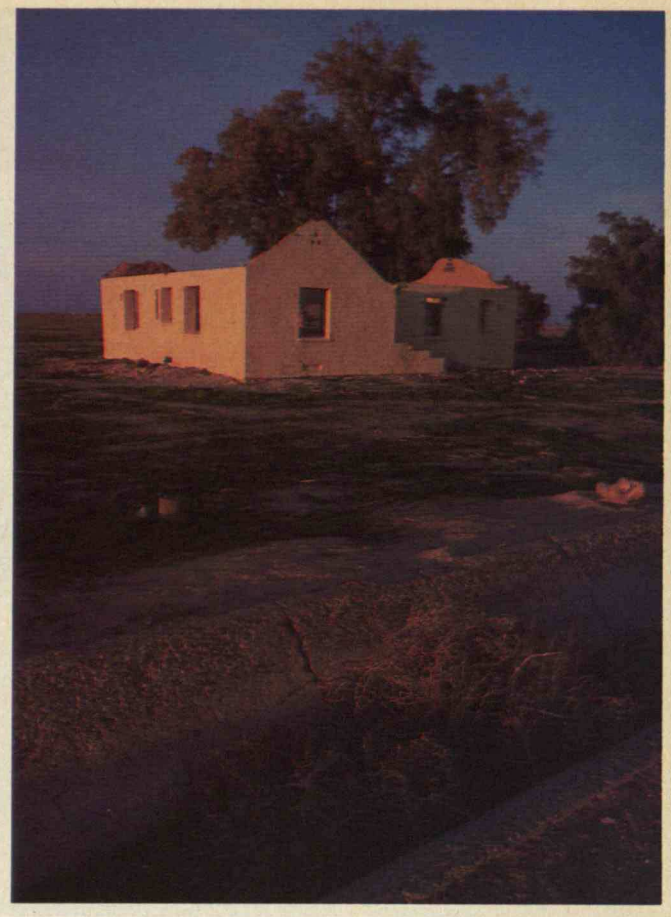
There are signs, which started to show even before the state added its legislative pressures, that the wasteful attitudes of the past are giving way. Since 1973, when city residents used about 200 gallons per person daily, the average water use has dropped by about a fifth.

The community erupted in 1982 when developers opened a huge swimming pool with machine-powered surf and a subdivision with 15 artificial lakes. In a stroke of hydrologic justice, neither project got off the ground. The wavepool, called Breakers of Tucson, didn't work and its owners filed for bankrupcy, although new owners have recently reopened it. The lake

PHOTOS: USDA-AGRICULTURAL RESEARCH SERVICE

The Santa Cruz River flows freely when it rains—and even floods during big storms—but the water soon vanishes (below, left and right). Since Tucson has no major supply of surface water, the city has turned to its underground aquifer. But overpumping has dropped the water table by 180 feet in some areas. Across the state, this problem has forced farms to be abandoned (far right) and triggered yawning earth fissures (right).





development ran out of money before a single house was sold. Today, standing deserted behind locked gates, the subdivision seems an anachronism, a symbol of a bygone era without limits.

Or is it?

Some people here are convinced that problems are well on the way toward solution. In fact, R.B. "Buck" O'Rielly, a politically powerful businessman and head of SAWARA, contends that Tucson doesn't have a water problem. He prefers to call it a "management resource challenge." But environmentalists are still worried. While they agree that laws and conservation campaigns may cut water consumption, they maintain that the water "saved" won't keep the desert from being taken over to house new arrivals.

Indeed, population growth may pose the biggest water problem of all. The Arizona Department of Water Resources estimates that urbanites will be the majority water users by 2025. However, the state's water law requires officials to fit the water supply to the expected population, not the other way around. Growth, the law assumes, is inevitable in this Sunbelt city. The law does require new subdividers to prove that their land has a dependable 100-year water supply. But legislators threw in a loophole big enough to drive a bulldozer through. For the next 20 years, anyone buying CAP water is presumed to have an assured 100-year supply.

This scenario may work better on paper than in real life, however. Under various laws and treaties, the Colorado River is committed to deliver 16.5 million acre-feet of water to seven Western states and Mexico. But its actual annual flow is estimated to be less than 15 million acre-feet. The problem for Arizona is that if there is a shortage, California gets its share of the water—4.4 million-acre feet—first.

But Wesley Steiner, head of the Arizona water resources agency, calls those who warn of CAP shortages "doomsayers." He reasons that a tight-fisted Congress will never appropriate the money for new water projects that would enable the upper basin states—New Mexico, Utah, Wyoming, and Colorado—to use all their allotted share of river water. That leaves plenty available for the CAP. He also contends that the reservoirs in the Colorado River basin will be able to bank enough water to handle any droughts.

Agriculture versus Population

Such optimism, however, could be melted by the "greenhouse effect"—a global increase in temperature and associated changes in precipitation that some scientists say will begin next century because of fossil-fuel burning today. In a study for the National Academy of Sciences, Roger Revelle and Paul Waggoner warned that such an effect could slash the Colorado River's flow by 40 percent.

Steiner calls the report "interesting but inconclusive." He notes that the report showed that temperatures in the Colorado River basin averaged 2 degrees higher from 1901 to 1930 than from 1931 to 1976—but the runoff was 20 percent greater during the early period as well. However, Revelle, a professor of science and public policy at the University of California at San Diego, cautioned in a recent interview that "you'd better abandon irrigated agriculture or abandon the idea of continued population growth."

If shortages do occur in the CAP, forsaking agriculture seems most likely. The state would probably buy farms around Tucson or along the Colorado to make up the gap. Another possibility is to use spreading basins and percolation ponds to shunt CAP water into the ground during years of abundance to save for droughts. This practice, called recharge, is used in southern California for trapping and storing rainfall and imported Colorado River water. As many as three demonstration recharge projects could begin here during the next decade, leading to full-scale recharge by the 1990s.

Beyond that, officials might have to turn to several as-yet-untested technologies for bringing in more water. These include

PHOTOS: PETER KRESAN, TERRENCE MOORE

Now dry most of the year, the Santa Cruz was once favored by waterbirds and picnickers such as these Sunday strollers in 1887. Tucson's growth is documented in this series of photographs spanning the past century.

An 1890 scene looking down Congress Street, where it crosses the Santa Cruz floodplain, shows irrigated fields with tree-lined ditches. By 1935 the fields are occupied by scattered houses, and urbanization has taken over by 1982. (Photographs courtesy of Julio Betancourt and Raymond Turner, from a U.S. Geological Survey publication now in press, and the Arizona Historical Society.)

cloud-seeding the mountains of the Colorado basin; water "harvesting," which uses cement ponds to store water that runs off streets and roofs; and building reservoirs along the streams to catch storm water before it runs away.

There are problems aplenty with these ideas. A recharge system could allow those who live "downstream" from the city water system—but who don't pay into it—to pump out expensively gained water for free. One proposed solution is to create a new metropolitan water agency, an idea that existing agencies not anxious to share their authority aren't welcoming with open arms.

Damming up stormwater or creating recharge ponds worries some flood-control engineers; they fear these practices could soak the ground and leave no breathing room during a big rain, which could mean larger floods than before. Studies in many California cities have revealed that there is often more lead in rainwater than drinking-water standards allow, which could force water harvesters to install treatment systems. And the notion that people might turn to their rooftops instead of taps for water strikes some authorities here as a bit unrealistic.

Beyond these ideas are the truly exotic ones, such as removing the salt from piped-in seawater or shipping icebergs from Antarctica to California, which would give its share of Colorado River water to Arizona in exchange. At one time, there was even talk among area officials of building a canal to bring in water from the Columbia River in the Pacific Northwest. But utter disgust among politicians and citizens in the Northwest prompted Congress to ban federal studies of such a canal until 1987.

Environmentalists prefer limiting population growth to what the area's local water supplies can support. One suggestion, for example, is to raise water rates so high that people won't want to move here, or that current residents will decide growth isn't worth the cost. But such controls seem unlikely.

For example, the Pima County Board of Supervisors, which controls zoning in most undeveloped areas, has a solid, pro-development majority, with many of its members receiving nearly two-thirds of their campaign contributions from homebuilders. The board approved more than 9 of every 10 rezoning requests from mid-1980 through 1982. And at a 1981 hearing of the county planning commission, officials from city and state water agencies warned that even with the CAP, the area's water supplies could ultimately limit growth. However, Peter Hershberger, the commission chairman, who is now a state legislator, replied, "If we can put a man on the moon, we sure as hell can pump seawater over from the Gulf of California." Yet the U.S. Army Corps of Engineers had already determined that desalinizing seawater, along with processing water from icebergs, is too expensive to be feasible in the foreseeable future.

The other solutions being considered aren't cheap either. Although CAP water is now sold at a discount to encourage use, it will eventually cost Tucson more than twice the $40 an acre-foot it pays to pump groundwater. That doesn't include the cost of treating the bacteria-laden river water to meet health standards. Golf courses will pay $300 an acre-foot or more to use sewage effluent. And if Tucson ever follows Denver's route and recycles sewage effluent for drinking, that, too, would cost more than $300 an acre-foot.

Farmers will pay $1,000 to $1,500 an acre for drip irrigation, compared with $200 or less for conventional methods, according to an official with the U.S. Department of Agriculture's Water Conservation Laboratory in Phoenix. Today farmers use drip systems on less than 30,000 acres in the state, says Dale Bucks, an irrigation engineer at the lab. A laser-leveling system, he adds, costs up to $15,000 to install.

While it is hard to imagine Tucson ever running out of water, it isn't so hard to imagine the city someday running out of money. □

The University/Industry Connection: Disclosing Ties

In a move guaranteed to be controversial, the editors of *The New England Journal of Medicine* have asked authors to disclose all ties they might have with businesses related to their research. This new policy is designed to "protect our readers" by letting them know about potential conflicts of interest, says Dr. Arnold Relman, editor of the medical journal.

"One does not have to assume that researchers are venal to appreciate that they may be affected (consciously or unconsciously) by economic incentives, which can influence the way they design or conduct their studies, how they interpret the results, or how and when they choose to report them," Relman wrote in a May 3 editorial announcing the new policy. "Disclosure, we believe, is in everyone's best interest."

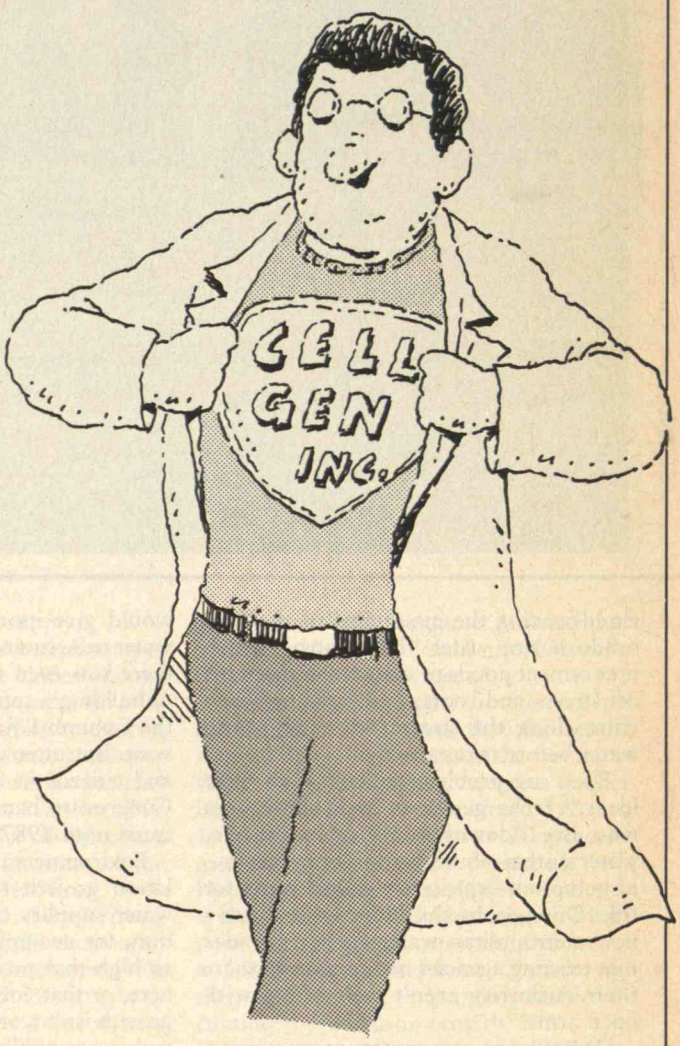
The *Journal* is the first publication of its kind to request full disclosure of authors' commercial ties, including part-time consulting work, ownership of stock or equity, and patent-licensing arrangements. The issue has aroused much debate as more and more university scientists become involved with firms interested in exploiting the powerful tools of genetic engineering. The *Journal*'s action is particularly significant because of the prestige it commands among medical researchers.

Many of these scientists are skeptical about the *Journal*'s new policy. It "sounds somewhat absurd," says Harvey Lodish, professor of biology at M.I.T. and a member of the Whitehead Institute for Biomedical Research. "Scientists have all kinds of private consulting arrangements with biotechnology companies and many own stock in these companies, but that's nobody's business. It has nothing to do with the quality of their research."

Lodish himself is a member of the scientific board for Damon Biotech, a firm that develops monoclonal antibodies for diagnosing and treating disease. But his laboratory research at M.I.T. doesn't directly relate to Damon Biotech's products, and even if it did, he says, "I don't feel I should tell editors that I consult with Damon Biotech. I don't see where there's a conflict of interest."

Harvey Price, executive director of the Industrial Biotechnology Association, a trade group representing 36 companies, notes, "Most scientists don't think their financial involvement in any way influences their opinion on scientific work. But most nonscientists do think it influences their opinion." Because of that growing credibility gap, Price believes the *Journal*'s policy of openness is a reasonable one to try—at least for a while.

So far no other scientific publication has followed the *Journal*'s lead. However, editors at *Science* magazine are considering the issue. "I'm glad the *Journal* has taken that position," says news editor Barbara Culliton. But she does not yet know whether *Science* should or will adopt a similar policy.



The British science journal *Nature* is not planning to adopt a policy of disclosure. "Almost invariably, the authors let us know when there are important conflicts of interest," says editor-in-chief John Maddox. "Our referees [the scientists chosen to review a particular article before it is published] tell us quite a lot. So there's really no need for this policy."

Maddox also notes that such a requirement would be "impossible to enforce," particularly with scientists in Eastern Bloc countries. Relman agrees that the *Journal*'s policy will be difficult to enforce, but he thinks that's immaterial. The policy, he says, is based on trust and puts the responsibility "where it belongs: on the authors."

However, if the editors did find out prior to publication that a scientist knowingly failed to mention an important conflict of interest, then, Relman says, "I don't think we would want to publish that paper."—*Alison Bass* □

ILLUSTRATIONS: JIM CARSON

A Cheap Ballistic-Missile Defense?

Though the idea of shooting down nuclear missiles with lasers or particle beams has a certain glamor, even advocates agree that such a ballistic-missile defense (BMD) is years away. But "kinetic-energy weapons," the high-tech version of cannon balls, might be deployed much sooner to do the same thing. The first such weapon was successfully tested by the army on June 10.

In the test a Minuteman I missile at Vandenberg Air Force Base in Southern California launched a dummy warhead toward the South Pacific. Twenty minutes later another Minuteman I was launched from the Marshall Islands carrying an interceptor vehicle—the kinetic-energy weapon—toward the warhead. The interceptor tracked the warhead with an infrared (heat) sensor linked to an on-board computer and opened a 15-foot umbrella-like structure to improve the chances of a hit. The interceptor struck the warhead at 20,000 feet per second and destroyed it, the army says.

Kinetic-energy weapons are "the simplest, cheapest, and fastest way to go" in defending against missiles, says Tom Krebs, director of research for The High Frontier, a BMD advocacy group. Even some opponents of BMD such as John Pike of the Federation of American Scientists agree that kinetic-energy weapons might provide at least a partial defense against missiles.

Deployment

Though the concept of a kinetic-energy weapon is simple, implementing an entire system would not be. A nuclear missile is most attractive as a target during its "boost phase," lasting about two or three minutes, when a single hit would destroy the missile's entire cargo of up to 10 (and in some cases even more) warheads. However, to do this kinetic-energy weapons would have to be launched from satellites, and that is not practical in the near term.

Instead, these weapons would probably be deployed during the next two phases—"midcourse," when the warheads have been released and are traveling through space (as was the Minuteman warhead in the test), and "reentry," when they are dropping through the atmosphere onto their targets.

The problem with a midcourse attack is that it might be thwarted if the Soviets launched huge numbers of decoys to overwhelm radar detection devices, says Pike. Even balloons might serve, as there is no atmosphere to slow them down.

Julian Davidson of the consulting firm of Booz, Allen and Hamilton says that decoys could be identified by "multioptical" systems—if some tough engineering problems are solved. These devices would reflect laser beams off targets and use sensors to detect the reflections. Sensors would also detect other electromagnetic radiation from targets such as heat and reflected sunlight. Pike agrees that to fool such sensors, decoys might have to weigh almost as much as warheads, and in that case decoys would not be worth using.

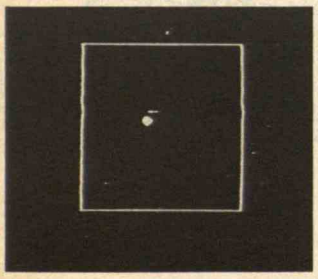
The midcourse defense would have to be reasonably effective. Otherwise, the "terminal" defense system to destroy warheads during reentry could be overwhelmed: the Soviets could concentrate huge numbers of warheads in one area. But if the midcourse defense provided some protection, a terminal defense could serve as a backup. Any light decoys would be easily identified in the atmosphere, so the defense would need to target only the real warheads.

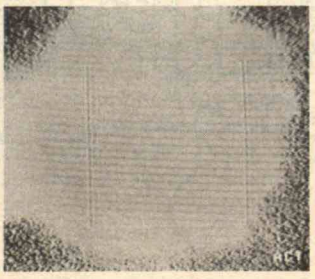
A complex coordinating system would be required. Sensors would follow warheads and decoys from the ground, aircraft, and satellites. Huge computers with programs of some 10 million lines would receive this data, track the warheads and decoys, and direct kinetic-energy weapons to the former but not the latter. According to a Department of Defense document, this computer system would have to function despite inevitable faults, resist radiation and shock waves from blasts, and hold up in the chaos of a nuclear war.

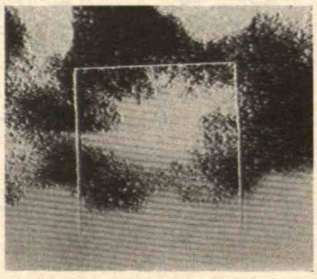
Pike agrees that such a system could work in principle: "The question is how well. A leaky umbrella works a lot better against a drizzle than a downburst."

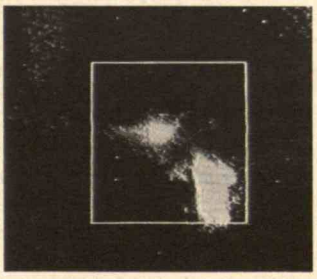
A Dangerous Defense?

Pike objects to such a BMD for precisely this reason. If the Soviets launched a massive first strike, kinetic-energy weapons might not provide much of a shield. However, if the United States launched a preemptive strike on the Soviets, destroying many of their warheads, kinetic-en-









In an army experiment over the South Pacific on June 10, an interceptor missile crashed into and destroyed a dummy warhead launched by a Minuteman missile. From left to right, video frames taken through a telescope show the impact. The white clouds are debris; the square frame follows the interceptor. (Photos: U.S. Army)

ergy weapons might protect against a feeble retaliatory strike. Thus, Pike argues that building a BMD would only fuel the arms race with added paranoia.

Fred Hoffman, head of a panel that examined the strategic implications of BMD for the secretary of defense, disagrees. Should U.S. commanders contemplate a preemptive strike, Hoffman does not feel they could rest assured that a "two-layer" (midcourse and reentry) defense could protect the country with impunity. However, he thinks that such a defense would give Soviet leaders pause as to whether they could achieve their goals in a first strike. Thus, he reasons that such a BMD would contribute to deterrence.

Rodney Jones, director of nuclear policy studies at the Center for Strategic and International Affairs at Georgetown University, agrees that a kinetic-energy BMD could be helpful *if* coupled with agreements to limit offensive weapons. Otherwise, each side would just deploy more warheads to penetrate the opponent's increased defenses. But Jones doubts that such agreements could be reached.

Furthermore, if the United States and the Soviet Union can reduce offensive weapons, they might as well do so without BMD, says Pike. He opposes deploying kinetic-energy weapons that could mean abrogating the existing ABM (antiballistic-missile) treaty. And he points out that the Soviets have an advantage, at least in terminal defense. Since their missiles are located close to population centers, both could be protected simultaneously. U.S. cities and missile bases are widely spread and would require a larger defense system.—*David Holzman* □

Reproductive Health Survey Cut

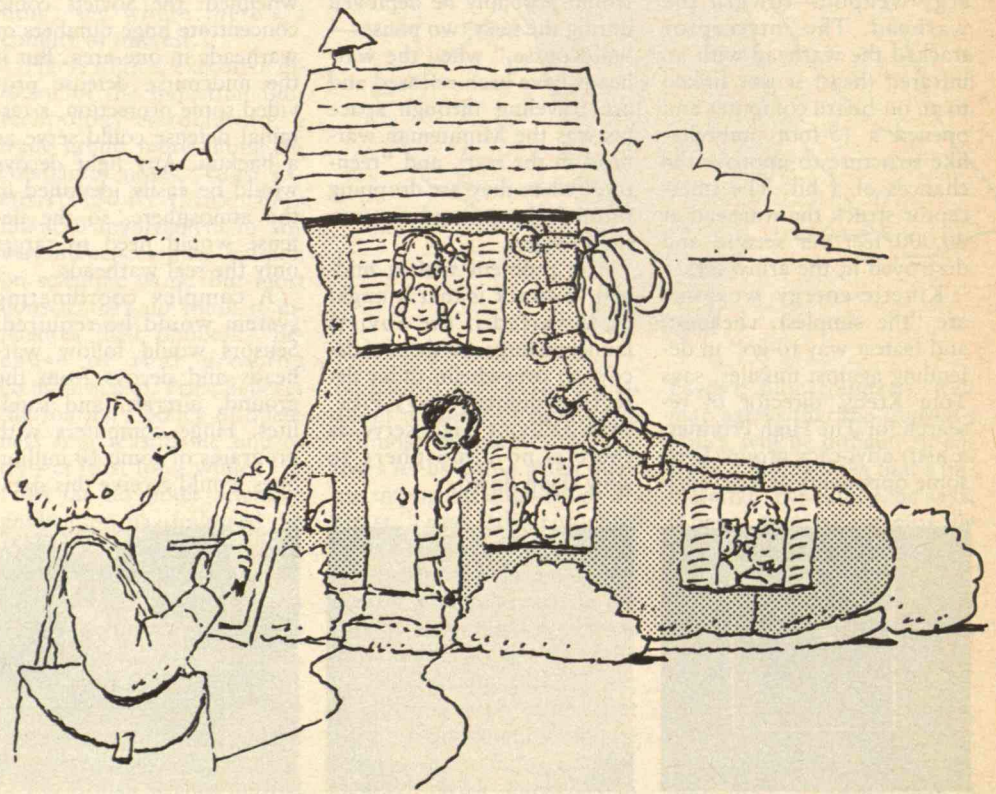
Every four or five years, the National Center for Health Statistics (NCHS) conducts a comprehensive survey of reproductive health in the United States. The survey gathers information on such basic questions as how many children couples are having, what kinds of problems they experience in conceiving, and how effective the contraceptives they use are. The results are used by the Centers for Disease Control (CDC) as well as many private organizations to pinpoint emerging problems in public health.

But in 1986, these agencies may have to look elsewhere for this information. For the first time in 20 years, the U.S. government has refused to fund this nationwide survey.

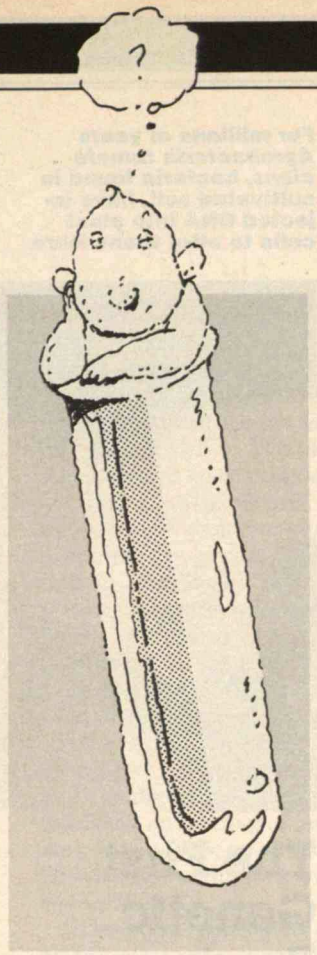
"Our request for this $3.5 million survey was not included in President Reagan's final budget," says Dr. William Pratt, chief of the family growth survey branch of the NCHS. "We are frankly puzzled as to why they would withhold this money." Pratt notes that the survey provides "a very important source of data to public-health researchers. For instance, the CDC uses our data to monitor the relationship between sexually transmitted disease and sterility."

Funding for the survey was not deleted by the President's Office of Management and Budget (OMB), which assembles final budget proposals for Congress. "The item was dropped by the Department of Health and Human Services (HHS) before it got to us," says OMB spokesman Ed Dale. HHS declines to explain why the survey was cut. "The budget process is internal information," says Alice Haywood, spokeswoman for the HHS.

A number of private agencies, including the American Public Health Association and Planned Parenthood, have protested the budget cut. But aides for the House Appropriations Committee don't know whether the funding will be restored. "All I can say is that we're aware of the problem and taking a look at it," says Jim Kulikowski, a minority staff member on the Subcommittee for Labor, Health, and Human services.—*Alison Bass* □



A Barren Time for Infertility Research



In Australia, government - funded doctors recently delivered the first baby to have been frozen as an embryo, thawed, and reinserted into its mother's womb. In England, where the first test-tube baby was born, government-sponsored physicians are publicly debating the issues raised by this technique. For example, some doctors have inserted more than three embryos into a mother's womb during the same cycle to increase her chances of becoming pregnant. However, a spate of quadruplet births from such multiple-embryo transfers has aroused concern.

In the United States, physicians are also performing in vitro fertilization—fertilizing embryos in test tubes and transferring them into the mother's womb. But because of a 10-year ban on federal funding for research on human embryos, a curious silence has settled over the whole issue. In the United States, there are no quasi-official bodies debating the medical, ethical, or legal boundaries of this controversial new procedure.

Experiments on in vitro fertilization have continued at a number of U.S. medical centers and clinics. But they are funded almost entirely by patient fees and are virtually independent of public scrutiny. The work, furthermore, is producing little basic knowledge about human reproduction.

"The absence of federal funding has removed the base of fundamental scientific research that should accompany any clinical application," says Gary Hodgen, former chief of pregnancy research at the National Institutes of Health (NIH). "If federal funding were there, every step of the process—from the quality of the egg and sperm to why some embryos are rejected by the womb while others are not—would be better understood." Hodgen stepped down from his prestigious post a month ago because of frustration over this issue. He is now scientific director of the privately funded Institute for Reproductive Medicine at Eastern Virginia Medical School in Norfolk.

Hodgen is most concerned that by ignoring the issue of test-tube babies, the government "has simply decided not to decide about an important new technology."

Four Years of Inaction

The ban on federal funding dates back to 1974, when Congress imposed a temporary moratorium on all fetal research. That moratorium was technically lifted a year later, but regulations required that all proposals to do such research be reviewed by a national Ethics Advisory Board (EAB). The board was not established until September 1978—three months after Louise Brown, the world's first test-tube baby, was born in England. Then Joseph Califano, secretary of the Department of Health, Education, and Welfare, instructed board members to study the ethical, medical, and legal implications of such research before ruling on particular proposals. The EAB did so for almost a year, according to Susan Abramowitz, a former staff member in the department.

In its report to Califano, the Ethics Advisory Board unanimously concluded that research on in vitro fertilization was "acceptable from an ethical standpoint." Its findings cleared the way for federal funding of research on human embryos prior to implantation, as long as such research had eventual therapeutic value and was approved by the EAB. But in 1980 the board was disbanded, and the Department of Health and Human Services (HHS), as it is now called, has simply sat on the recommendations.

About a year ago, the NIH attempted to resurrect the issue by sending a request for reestablishing the advisory board to HHS. But HHS Secretary Margaret Heckler has yet to rule on the issue. "It's clear that it is not just a matter of delay," Hodgen says. "There are obviously some people who don't feel this research should be funded."

Some physicians have argued that federal support for in vitro fertilization should have low priority because they believe this country faces health-care problems more deserving of attention than infertility. Other opponents, notably right-to-life advocates, consider all research on embryos morally unacceptable; they believe embryos enjoy the rights accorded to a human being.

"Infertile couples don't have anywhere near the political clout of the right-to-lifers," says George Annas, professor of health law at Boston University Schools of Medicine and Public Health. "Federal funding for in vitro fertilization is not going to happen while Reagan is President." However, Roger Woodward, an assistant to Heckler, said the political ramifications of the NIH request have nothing to do with the current impasse: "Heckler wouldn't even know who's supporting the reestablishment of the board and who's not."

Whatever the reason, the fact remains that in vitro fertilization is off-limits to most of the 1 million childless couples who might benefit from it today. Insurance companies have refused to cover what they consider an experimental procedure. Since achieving pregnancy requires an average of three fertilization attempts, and each attempt costs between $3,000 and $7,000, most couples can't afford to keep trying.

"If I needed in vitro fertilization," Hodgen says, "I'd want the government to do its job and help fund the basic research programs needed for its development. The government is doing that with heart transplants. Why can't it do the same for in vitro fertilization?"—*Alison Bass* □

For millions of years *Agrobacteria tumefaciens*, bacteria found in cultivated soil, have injected DNA into plant cells to alter them. Here the *Agrobacteria*, gathering at the surfaces of larger plant cells to inject DNA, are being put to work by genetic engineers.

The First Genetic Engineer

Just when the first products of genetic engineering such as interferon and insulin are appearing on the market, scientists have discovered that they weren't the first to profit from gene splicing. For millions of years *Agrobacterium tumefaciens*, a bacterium found in all cultivated soil, has been inserting genes into plants and causing them to produce custom-tailored nutrients. Scientists may be able to use the genetic-engineering techniques developed by this bacterium to revolutionize agriculture.

A number of scientists have been studying the *Agrobacterium*, and large companies such as DuPont, as well as several smaller genetics firms, are working to put its techniques to use. Jeff Schell, the acknowledged leader in the field who heads labs at the Max Planck Institute in Germany and the University of Ghent in Belgium, found that the *Agrobacterium* adds some of its own DNA to the DNA of plants, causing them to manufacture opines. These chemicals, which are formed from amino acids, the building blocks of proteins, provide nutrients for the bacterium. Since most bacteria and plants cannot derive nourishment from opines, the *Agrobacterium* can, in effect, synthesize food especially suited to itself—a selective advantage in evolution.

The process begins when an *Agrobacterium* invades a plant, usually at a wound. The bacterium contains a plasmid, a circular piece of DNA. Through a mysterious process known as transposition, the plasmid transfers several genes—basic units of genetic information—to the DNA of a plant cell. These genes carry instructions for, among other things, synthesizing opines.

But as any genetic engineer knows, you need a "clone" of millions of identical cells to produce a copious supply of material. The *Agrobacterium* has found an interesting way of cloning plant cells—it induces cancer. In addition to housing the genes for opine synthesis, the plasmid contains cancer-causing "oncogenes." Thus, the single altered plant cell grows wildly into a tumor, and every cell of the tumor produces opines.

Human scientists couldn't have designed a better system to engineer plants. In fact, they're not even trying. Instead, Schell and his colleagues have learned how to exploit the bacterium's engineering abilities to transfer genes into plants. They have succeeded in removing the genes for synthesizing opines and the oncogenes from the plasmid, leaving only the part that makes the gene tranfer possible.

A biologist may insert genes into this remaining part of the plasmid while it is still in the *Agrobacterium*. The biologist then cuts up leaves from a plant, separates the cells, and places them in a dish with the engineered bacteria. The bacteria transfer the genes into the plant cells, as usual. Through a process that has already been developed, the biologist clones the plant cells containing the new genes to grow entire plants. Genes inserted into plants in this way have been used to make the plants resistant to certain drugs, for example.

The *Agrobacterium* may prove useful in studying human cancer, but scientists are even more hopeful about the prospects of using this bacterium's engineering abilities to improve agricultural crops. For example, scientists such as Frederick Ausubel, a professor in the genetics department at Harvard Medical School, are studying the genes that allow some bacteria to "fix" nitrogen from the air, putting it into organic compounds that can fertilize plants. The aim is to remove nitrogen-fixing genes from such bacteria and convert them into forms that can function directly in plants, allowing them to manufacture their own fertilizer.

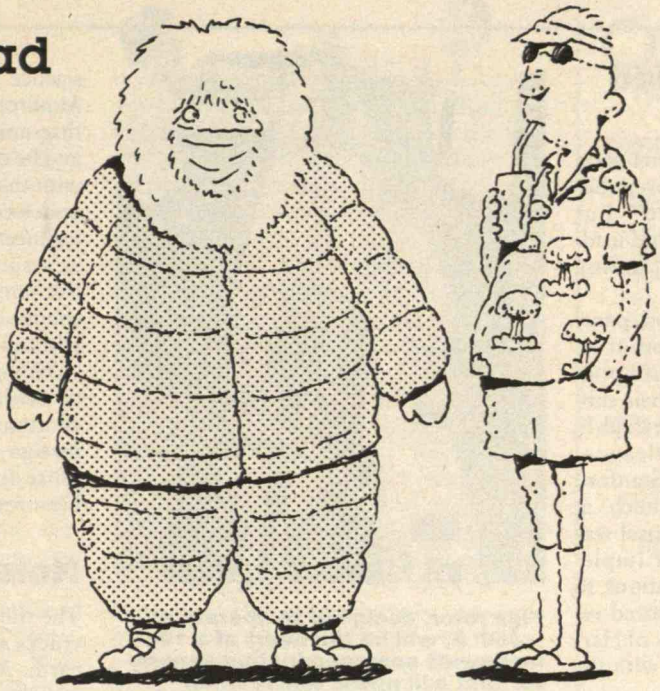
Results may not come quickly. "Some 15 to 20 genes in plants with 5 to 10 million would be necessary to control nitrogen fixation, and all these genes would have to function as a unit," says David Pimentel, a prominent Cornell entomologist. Producing a plant that can fix nitrogen "will be quite an engineering feat," perhaps taking 10 to 20 years.

If plants spend part of their energy fixing nitrogen, Pimentel estimates that crop yields per acre might be reduced by 5 or 10 percent. Nevertheless, when nitrogen-fixing plants are engineered, they will be a "tremendous boon" to agriculture, Pimentel says. "The greatest fossil-fuel energy input into agriculture is for nitrogen-containing fertilizer."

Bioengineers hope that other new genes inserted by the age-old techniques of the *Agrobacterium* might create plants that produce higher yields, resist pests, or grow on soil too poor to farm today.—*Robert Moss* □

PHOTO: MONSANTO

Must War Lead to Winter?



The heart-chilling concept of the nuclear winter—a period of bitter cold all over the earth that could follow even a limited nuclear war—is about to come under the microscope of scientists and policymakers. A series of studies will examine the most recent version of the theory, check the claims of critics that the whole idea is badly flawed by lack of data, and determine any changes in nuclear defense policy that would be necessary if nuclear winter could arise.

The trail of events that would create a nuclear winter is devastatingly simple. A sequence of nuclear explosions would set off huge fires in forests and major cities. The fires would inject soot, smoke, and dust high into the atmosphere. This debris would blot out much of the sunlight that normally reaches the earth's surface, reducing our planet's surface temperature. If the reduction were large enough—more than a few degrees, on average, across the globe—it would virtually end productive agriculture for years, even in regions far distant from the impact of nuclear weapons.

The possibility that a nuclear holocaust could cause devastation beyond the effects of mushroom clouds was first raised two years ago by Paul Kreutzer of West Germany's Max Planck Institute, and John Birks of the University of Colorado, in the Swedish journal *Ambio*. But the idea hit U.S. headlines late last year when a group headed by Cornell University astronomer Carl Sagan publicized its own study, which appeared in *Science* in December. According to the group's calculations, a nuclear conflagration involving 5,000 megatons of explosives would set such large fires that an extended period of cold would be inevitable. Even a "limited" nuclear exchange, involving just 100 megatons detonated in major cities, would lead to a nuclear winter, according to the group's model.

How accurate is the scenario? Sagan's group admitted that its study was preliminary. And in recent months, questions have arisen about the numbers used by the Sagan team. In particular, critics have suggested that the group's assumptions about the amount of soot and dust likely to reach the upper atmosphere after a nuclear war are unrealistically high. An analysis by George Rathjens and graduate student Ronald Siegel at M.I.T., for example, casts doubts on the claim that large amounts of soot would find their way to altitudes of several kilometers after a conflagration. "It's not often that you'll get a high soot content and a high injection altitude simultaneously," cautioned Siegel. "Normally, different types of fires produce the two effects. Sagan's group seems to be looking at a little bit worse than the worst-case situation."

The spectre of the nuclear winter—and the doubts about its magnitude—have sparked a series of official and semiofficial studies of the potential catastrophe. The National Academy of Sciences, for example, started work in March of last year, before the celebrated Sagan study was released, on a report tentatively due for publication in August. It is expected to review, among other things, current knowledge of massive fires, derived mostly from the World War II burnings of Dresden, Hamburg, Hiroshima, and Nagasaki.

Alan Hecht of the National Oceanographic and Atmospheric Administration heads a government interagency team trying to develop a national plan for research on the nuclear-winter hypothesis and its implications for federal defense policy. The plan is expected to go to presidential science adviser George A. Keyworth II in September. According to Hecht, it will contain two major ingredients: a recommendation for a series of fire experiments, starting in the laboratory and moving out to small studies with accidentally or deliberately set forest fires; and suggestions for major improvements in modeling the effects on weather of huge fires. Fires of that magnitude, Hecht says, "create their own meteorology."

"The Sagan report perforce makes a lot of assumptions and rough calculations, because data are hard to come by or nonexistent," explained Hecht. "It stated the hypothesis and made a big jump by assuming that enough smoke would remain in the atmosphere to create cooling. My view is that you can push at the hypothesis in many ways, but you can't ignore it. It deserves testing."

While testing will obviously clear up some of the climate-modeling problems that surround the concept of nuclear winter, many questions will remain. On the positive side, the scientific controversy over the issue has forced scientists and policymakers to think seriously about the unthinkable. And for the public at large, the brouhaha has shown, as physicist Freeman Dyson of Princeton's Institute for Advanced Study put it in *The New Yorker*, "that the world's ignorance of the effects of nuclear war is even greater than anyone had realized."—*Peter Gwynne* □

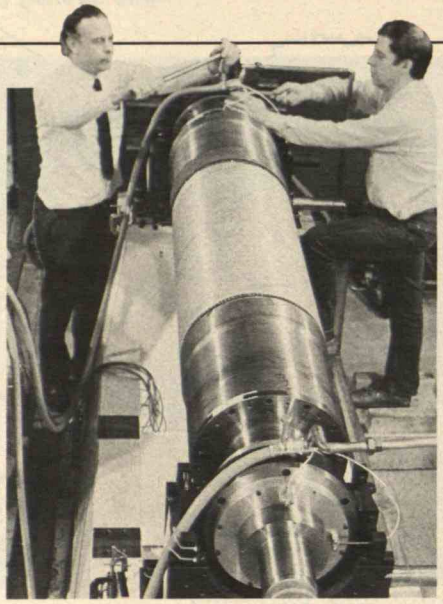
When Is Unclassified Really Classified?

The Pentagon made another excursion into the controversial turf of "prepublication review" of "sensitive" but unclassified research last spring, and leading research universities—including M.I.T.—were quick to respond.

In April, a Defense Department panel called for reviews by the Pentagon of all technical papers reporting defense-sponsored research prior to or upon their submission for publication. President Paul E. Gray of M.I.T. joined two colleagues (Presidents Donald Kennedy of Stanford and Marvin L. Goldberger of Caltech) in sending a terse warning: the proposal was unacceptable, they said, and if implemented would force their institutions to withdraw from all defense-sponsored research. (Later President Derek Bok of Harvard formally associated himself with the same letter.)

George A. Keyworth, presidential science adviser, later told Robert C. Cowen, science editor of the *Christian Science Monitor*, that he was "determined to see that universities are not so constrained," and he quoted President Reagan as aligned with that position. And Richard DeLauer, undersecretary of defense for research and engineering, was later quoted by *Science* as assuring the academic community that "defense contracts with universities should be either classified or unclassified, with no publication controls."

Though the dust once more seemed to be settling, there was no sense that the continuing controversy about "leaks" to foreign countries of technology from defense-funded unclassified research had been resolved. □



This rotor, designed to operate at −450° F, will be the heart of a 10-megawatt superconducting generator that will power M.I.T. when tested in 1985. In the picture: Professor Joseph L. Smith, Jr., and Stephen D. Umans.

Noisy Arctic Seas

The thin crust of ice on the Arctic Ocean cracks and quakes just like the crust of the earth. As the ice floats on its sea magma, it "bumps, grinds, tears, and squeaks," says Peter Stein, a graduate student in ocean engineering at M.I.T.

Stein and his colleagues from M.I.T. and the Woods Hole Oceanographic Institution were studying underwater acoustics in the Arctic Ocean when they were distracted by the high levels of background noise—ten times that of the open ocean. Now Stein has become an expert in differentiating ice sounds resulting from compression and shear, and in using those sounds to predict "icequakes."

For example, high-stress ice fractures that can smash ships and topple oil-drilling towers are associated with low-frequency sounds, he says, while high-frequency sounds generally result from harmless thermal cracking as, for example, day yields to night. And sonar operators beware: some ice cracking causes sounds quite like those caused by the passage of a submarine.□

Tribology on Video

The new video courses on tribology—the technology of wear and its elimination—are now available from the M.I.T. Center for Advanced Engineering Study. They're the work of Professor Ernest Rabinowicz of M.I.T., who has also prepared course manuals, a source book, and a textbook to accompany the video material. For information: Beverly D. Thatcher, Room 9-234, M.I.T. (617) 668-8360. □

PHOTO: CALVIN CAMPBELL

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great hope for one type of interferon as well as a drug called interleukin two. However, neither medication is panning out. With a disease as complex as this one, the light at the end of the tunnel has a nasty habit of flickering brightly and then going dim.

Public health crises can be contained only so long by politics. It has been the Reagan administration's good fortune that in the United States, AIDS has been primarily confined to male homosexuals, intravenous-drug abusers, Haitian immigrants, and hemophiliacs. None of these are "there but for the grace of God go I" groups, and three are populations hardly favored by the public at large. But that could change, given the frequency with which people travel in the jet age.

Right now Africa has almost twice as many AIDS victims as the United States, and most seem to be heterosexual. Male victims outnumber females, as they do here, but only by a ratio of three to two. This means that a lot more people may be at risk of AIDS than is generally assumed.

And even should AIDS miraculously vanish, one can't help but wonder what bizarre epidemic will be next. Whatever it is, the federal machinery now in place will not be equipped to tackle it with all deliberate speed. Part of the problem is that the Public Health Service is too vulnerable to partisan politics and the attitudes of whatever administration is in power. University scientists and some Democratic representatives have questioned whether slowness of funding for AIDS was due to the prejudice of some government officials (and scientists) toward the groups afflicted.

To avoid this problem in the future, Congress last year passed legislation for a "trigger mechanism" that would automatically allocate emergency money once an epidemic has been recognized. The trouble is that no money for this contingency fund has been appropriated. It would also help if a central agency—perhaps the CDC or the surgeon general's office—were made clearly responsible for coordinating response to a nationwide outbreak of disease. In the case of AIDS, one federal agency often did not know what the other was doing.

As one scientist observed at the AAAS workshop in May, "AIDS is a tragic problem, but what if it was a much larger problem? We'd really be in trouble then." □

Continued from page 17

Power concern style more than substance. The book is a tract, or more accurately a brief, constructed to propel society more quickly down the soft path. The authors artfully present data, anecdote, and circumstance that promote this end. But they feature reservations, limitations, and qualifications much less prominantly. As with other causes, reality is far more ambiguous than it appears to most "true believers." When the evidence is in, I belive society will ultimately judge that the Lovinses are right in their claims about energy technologies more often than they are wrong. But, in appraising their work today, I must limit my endorsement to the questions they ask rather than all the answers they give. □

IRVIN C. BUPP, formerly an assistant professor at Harvard Business School, is now a partner at Cambridge Energy Associates, in Cambridge, Mass.

Continued from page 3

Ricks says that it is illogical to consider Murphy's Law an argument for BMD. Murphy's Law implies that in the worst case of a nuclear war, BMD could fail to stop even one warhead. But in the MAD scenario, even if everything works perfectly during a nuclear war, we lose hundreds of millions of people to blast and fire, with most of the rest of us dying from radiation poisoning, starvation, and nuclear winter. This is because MAD is *intended* to be mutually assured destruction. The *best* MAD scenario is as bad as the *worst* BMD scenario.

Murphy's Law also tells us that if we rely indefinitely on these weapons of mass destruction, we *will* get a nuclear war. If BMD were to lead us to become more complacent about our need to end development of nuclear weapons, it will have failed in its larger purpose: to encourage disarmament.

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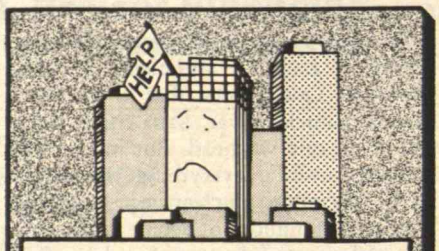

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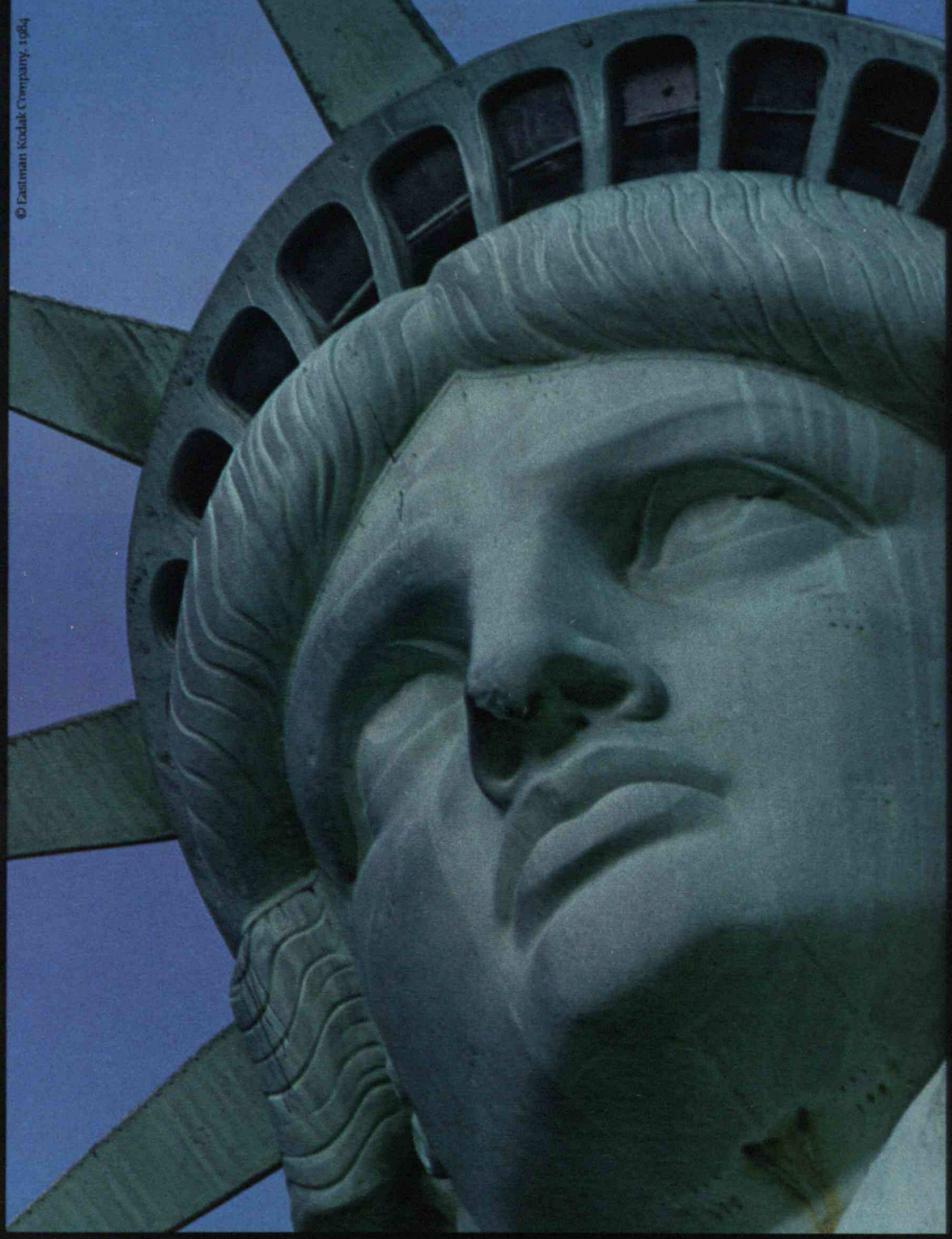

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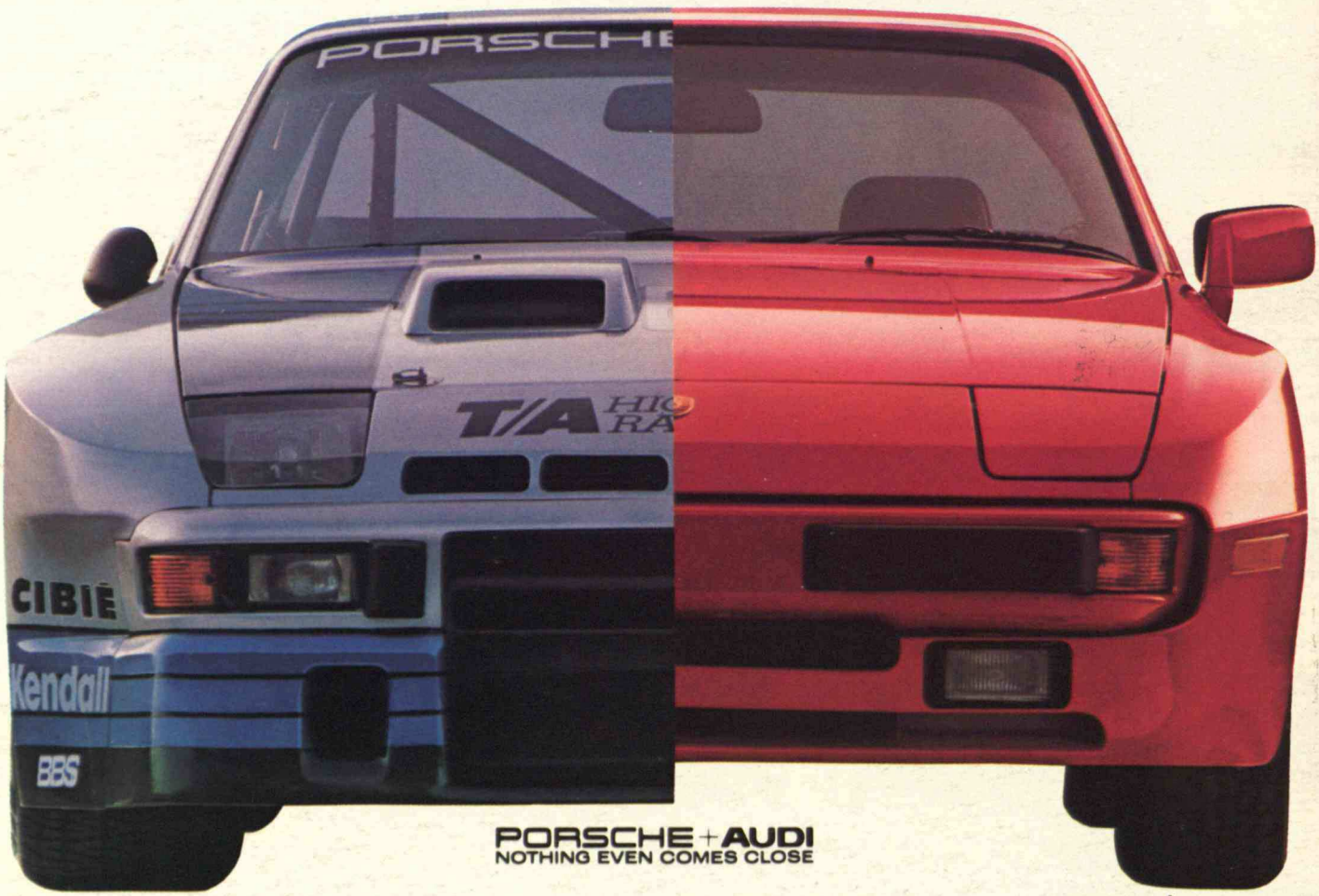

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